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I
EXPEDITION TO THE REVILLAGIGEDO ISLANDS,
MEXICO, IN 1925

GENERAL REPORT

BY
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INTRODUCTION

Early in January, 1925, at a conference of the Director and curators of the various departments of the Academy, it was decided that suitable and desirable field work for the ensuing season could be done on the Revillagigedo Islands, Mexico, if arrangements could be made to go there with a reasonable degree of economy. A tentative plan of organization was drawn up which met the approval of all concerned and steps were taken to secure a suitable means of transportation.

The Revillagigedo Islands lie about 840 miles a little east of south from San Diego, California, and 240 miles a little west of south from Cape San Lucas, Lower California. They are several degrees south of the Tropic of Cancer; they extend in an east west line about 250 miles and close to the nineteenth parallel of north latitude. The group consists of four islands in order of size as follows: Socorro (with the small detached Oneal Rock); Clarion; San Benedicto; and Roca Partida.

March 30, 1926

Obviously, to reach these far distant and widely separated islands and make a proper exploration of them, a very substantial and reliable vessel would be needed. This, the Academy does not possess, and all agreed that present charter rates for such a ship would more than exhaust the limited amount of funds which could be allotted each year to such purposes.

Two possibilities were suggested as means for the provision of the necessary transportation. The first was to invite the interest of some friend of the Academy who possessed a suitable vessel. But in the absence of any definite information regarding such a proposition it was dismissed as offering little hope.

Knowing the willingness of the Navy Department to cooperate in legitimate undertakings of scientific and public interest, it was thought possible that, if the situation were fully explained, a vessel might in that manner be secured for the proposed exploration. Application was therefore formally made on January 15, 1925, to the Secretary of the Navy, Hon. Curtis D. Wilbur by Dr. Barton Warren Evermann, Director of the Academy. The following letter gave the essential details of the proposition:

SAN FRANCISCO, CALIFORNIA,
January 15, 1925.

HON. CURTIS D. WILBUR,
Secretary of the Navy,
Washington, D. C.

My dear MR. SECRETARY:

The California Academy of Sciences has for many years been deeply interested in the fauna, flora, and geology of the islands off the coast of California, Mexico and South America. It has sent out in past years a number of expeditions to various ones of these islands. In 1905-6, nearly two years were devoted to a study of the Galapagos which added greatly to the knowledge of those classic islands. In 1920 another party studied the fauna and flora of the southern end of Lower California. In 1921 a study extending over several months was made of all the islands in the Gulf of California. In 1922, a similar expedition was sent to Guadalupe, Cedros and other islands off the Pacific coast of Lower California. The 1921 and 1922 expeditions were made possible by the very helpful cooperation of the Mexican Government, and did much toward establishing pleasant relations between the scientific men and local officials of that country and the scientific men of this country.

The Academy is now ready to enter upon a study of the Revillagigedos, a group of four islands (Clarion, Socorro, San Benedicto and Roca Par-

tida), lying off the coast of Mexico, about 360 miles nearly due west from San Blas, or 240 miles southwest from Cape San Lucas, or about 840 miles south of San Diego.

These islands are the most isolated group on the coast and a study of their fauna and flora and a comparison with the species found on the mainland, should enable us to arrive at the origin of the island fauna and flora, and their relationships to the mainland.

The Academy is very anxious to send an expedition to these islands to make a comprehensive and thorough biological and geological survey of them. Special attention would be given to the botany, land mollusks, insects, reptiles, birds and mammals.

The requirements for the expedition would be:

1. *A suitable vessel.* One of the Eagle boat type would be best. A vessel such as the *Tanager* or the *Whippoorwill* recently detailed to the Bishop Museum at Honolulu for expeditions to various Pacific Islands would be ideal.

As there is no water on any of these islands, the investigators would not be able to remain on shore longer than a day or two at a time, but would ordinarily have to return on board each evening. The vessel would therefore have to keep in daily touch with the shore party or parties.

2. It is estimated that the work on the various islands will require a total of six to eight weeks.
3. The best time would be from late in April to about June 30.
4. A scientific (civilian) staff of seven to nine men, two of whom, it is hoped, will be scientific men from the Museo Nacional de Mexico, who would virtually represent the Mexican Government.

Knowing that it is the policy of our Government to assist public scientific and educational institutions such as the California Academy of Sciences in projects of this kind, by detailing vessels of the Navy for the purpose, I wish to ask, on behalf of the Trustees, Council, and members Academy of Sciences if the United States Navy would be disposed to assist the Academy in carrying on this proposed investigation by detailing a vessel suitable for the purpose. The Academy has no vessel suitable for such an expedition, nor has it funds for chartering a vessel.

It is thought that one of the boats now, or that may be, at the San Diego station might be available. It is also believed that such an expedition would yield results not only of great scientific interest and value but of interest and value to the Navy, as there would be opportunity to do a great deal of hydrographic work, such as soundings, ocean temperatures, ocean currents, and plankton studies.

While the income of the Academy is small, we would expect to meet such of the expenses of the expedition as can not properly be paid by the Navy.

Hoping this suggestion may receive your early and favorable consideration, I have the honor to be,

Very respectfully yours,

(Signed) BARTON WARREN EVERMANN,
Director.



In due time and coincident with the taking of the necessary steps for the detail, Secretary Wilbur advised Dr. Evermann in the letter quoted below that the mine-sweeper, *Ortolan*, would be allotted to the work.

WASHINGTON, D. C.,
March 2, 1925.

Dear Sir:

For the biological and geological survey of the Revillagigedo Islands the Navy Department will be able to provide a mine sweeper similar to that used in the surveys of islands south of the Hawaiian group.

The *Ortolan* has been designated for this duty. The Commanding Officer of the *Ortolan* has been directed to report to the Commandant, Navy Yard, Mare Island, not later than April 16, for such preparation for the expedition as is deemed necessary.

It will be necessary for the Navy Department to inform the Mexican Government through the State Department of the intended visit of the *Ortolan* to the Revillagigedo Islands; but before doing this it is requested that you state definitely the number of scientific men you desire to have accompany the expedition from Mexico and whether or not you desire to limit the invitation to men from the Museo Nacional de Mexico. This information is desired in order that the invitation may be extended to them at the same time that authority is obtained for sending the expedition.

Dr. Chas. D. Walcott, of the National Museum, has requested a set of the specimens collected for deposit in the National Museum at Washington, D. C. Will you please communicate with him on this question and the question of freight for shipment of specimens collected, as the Navy Department has no authority for payment of freight. However, the Navy Department could transport specimens from San Francisco to Hampton Roads via Naval transport, with the idea that the National Museum would pay the freight from that point and would defray the expenses of packing.

For further details and for arrangements concerning the expedition you will please communicate with the Commandant, Navy Yard, Mare Island. The *Ortolan* may leave on the expedition as soon after April 16th as ready, and should arrive at Navy Yard, Mare Island, for scheduled overhaul on June 22.

Respectfully,

(Signed) CURTIS D. WILBUR.

DR. BARTON W. EVERMANN,
Director of the Museum,
California Academy of Sciences,
San Francisco, Calif.

The actual organization of the expedition then proceeded rapidly under the guidance of Dr. Evermann and the essential details will be found in the pages following. Before proceeding, it is desired to express the great appreciation of the Acad-

emy and all of its integral departments for the fine spirit of cooperation shown by every one in the Navy Department directly concerned. It is realized by all of us that considerable sacrifice was necessary in the withdrawal of the *Ortolan* from the proposed maneuvers in the Pacific and the detail of the vessel to other duty.

Appreciation is also due to the hearty cooperation of the representatives of the Government of Mexico who accompanied the expedition.

And lastly, it should be stated that the responsibility for the smooth-working, machine-like organization which left San Francisco on April 15, 1925, rests with Dr. Evermann, Captain M. M. Nelson of the *Ortolan*, the members of his crew, and the scientific staff. I am sure that all participants will long cherish happy memories of the two months spent on virgin islands in a tropical sea.

PURPOSE OF THIS REPORT

The purpose of this report is to give as briefly as possible the details pertaining to the organization of the expedition; an itinerary; and a running narrative with general information and facts of interest. The detailed studies based upon the large collections obtained will naturally follow in separate reports by various specialists. The reader is therefore referred to these latter for definite data pertaining to the species of animals and plants inhabiting the region.

ORGANIZATION

The arranging of the details of the expedition consisted largely of selecting a scientific personnel and the requisite equipment. The first was a relatively simple matter, and after due consideration of all conditions which could be foreseen the following persons were chosen to represent the various departments:

1. *Botany*: Mr. H. L. Mason, then Professor of Botany at Mills College, California.
2. *Entomology*: Mr. Hartford H. Keifer, Assistant Curator, California Academy of Sciences.

3. *Herpetology*: Mr. Joseph R. Slevin, Assistant Curator, California Academy of Sciences.

4. *Ornithology and Mammalogy*: Mr. Frank Tose, Chief Taxidermist and Mr. John Wright, Assistant Taxidermist; California Academy of Sciences. It was recognized that the collection and preparation of birds, eggs and mammals in the tropical climate would be one of the most difficult tasks of all. Therefore, not only were two men selected to do the work, but a large amount of special equipment was taken to lighten the labors and insure the making of a representative collection. Most important of this equipment was the installation on the after deck of the *Ortolan* by the Navy Department, of a special ice machine for the preservation of specimens which could not be immediately cared for. This machine was removed from a Destroyer in San Diego for the purpose, and proved to be a most valuable addition to the equipment. Numerous birds were brought back to San Francisco in a frozen condition, there placed in cold storage, and finally prepared in the usual manner as opportunity offered.

5. *Paleontology*: Dr. G. Dallas Hanna, Curator, and Mr. Eric K. Jordan, Assistant Curator, California Academy of Sciences. In addition to the regular collection of fossils and living shells, these two representatives were expected to make general collections of marine life including invertebrates and fishes. For the latter purpose two seines, a small beam-trawl, two dredges, two hoop-nets, hooks, lines, dip-nets and a liberal supply of nitrogelatin were taken along. Also four "live tanks" were installed on the deck of the *Ortolan* and there provided with facilities for circulating sea water in order that some fishes might be brought back alive for exhibition in the Steinhart Aquarium. The taking of a series of still camera pictures throughout the trip devolved upon one of us and for the purpose a 4x5 Graflex camera was used almost exclusively. As a result approximately 400 pictures suitable for reproduction were obtained.

6. *Motion Picture Photography*: Mr. Raymond Duhem, of San Francisco. The desirability of securing a series of

motion pictures was apparent to all. Mr. Duhem was provided with two cameras and about 10,000 feet of excellent negative was produced.

Lieutenant Neil B. Musser of the Construction Corps of the U. S. Navy, then stationed at the Mare Island Yard, took a very active part in the preparation and outfitting of the *Ortolan* and was so impressed with the plans that he obtained leave and accompanied the ship during the cruise as a detached observer. He rendered valuable aid to the collectors in many ways and secured a large collection of still pictures which he has presented to the Academy for its records.

The Academy has been engaged for many years in making explorations in Mexican territory chiefly among the western islands and has always enjoyed the heartiest cooperation from the authorities of that country. Whenever possible it has been the policy to invite scientific representatives from there to accompany its expeditions. Therefore, Dr. Alphonso Herrera, Director of the National Museum of Mexico was asked to name two or three men to join the Revillagigedo Islands Expedition and the following gentlemen joined the ship at San Diego: Professor Francisco Contreras, Assistant Director of the National Museum of Mexico; Professor Jose M. Gallegos, Explorer of the Department of Fomento and Agricultura; and Señor Octavio Solis, Director of the Botanical Garden of Chapultepec, Mexico.

These men grasped the opportunity to secure large collections of natural history from some of their least known territory and proved to be most delightful companions throughout the work. Through them the expedition was able to enjoy exceptional privileges at various places.

Before departure Dr. Evermann drew up a set of instructions which gave some further details of operation and organization of the expedition. To this was appended some detailed plans and instructions prepared by the various curators. It was not expected that every condition to be encountered could be anticipated in advance and these thoughts were inspired by a desire to outline in general terms only the plans to be followed.

INSTRUCTIONS FOR GUIDANCE ON THE EXPEDITION

SAN FRANCISCO, CALIFORNIA,

April 11, 1925.

DR. G. DALLAS HANNA,
California Academy of Sciences,
San Francisco, California.

DEAR SIR:

Referring to the proposed expedition of the California Academy of Sciences to the Revillagigedo Islands, the following instructions are issued for your information and guidance:

1. *Purpose of the Expedition:* As comprehensive and thorough biological and geological survey of the islands as time and equipment permit.
2. *Vessel:* At the request of the California Academy of Sciences the Secretary of the Navy has detailed the U. S. S. mine-sweeper *Ortolan*, Lieutenant M. M. Nelson commanding, to the Academy for use on the expedition.
3. *Personnel of scientific staff:* [See above.]
4. *Itinerary:*

a. The *Ortolan* will depart from Mare Island Navy Yard on April 15. The first stop will be at San Diego where certain supplies for the ship will be taken aboard. At that time a supply of bottles for water and plankton samples desired by the Scripps Institution will be received. From San Diego the expedition will proceed to Clarion Island, stopping *en route* at Guadalupe Island long enough to make a census of the elephant seal herd which is found there, and to do such collecting as at the time may seem desirable. If tide conditions are favorable a search should be made for fur seals, a few of which may still occur there.

The survey of the Revillagigedos will begin with Clarion Island unless, perchance, Captain Nelson should, for ship's reasons, think best to begin elsewhere. The order in which the different islands will be visited will be determined by the Commanding Officer after consultation with you. The time that will be devoted to the work on and about each island and the sequence will be determined by you, always, of course, after conference with the Commanding Officer. It is of vital importance that as much time as possible be devoted to these islands that the survey may be final in its results so far as the Academy is concerned.

It is expected that, during the time the expedition remains at these islands, the Commanding Officer will take advantage of the opportunity to do hydrographic work of importance to the Navy and to science. In this work you will, of course, render any assistance desired.

- b. *Tres Marias Islands*: Upon completion of the investigations at and about the Revillagigedos, if time permits, it is expected the vessel will visit Mazatlan, which will afford an opportunity to do some work at the Tres Marias Islands which will be of great importance to a proper interpretation of the fauna and flora of the Revillagigedos.
 - c. *Magdalena Bay, etc.*: On the return northward it is hoped that time will permit stops at San José del Cabo, La Paz, Magdalena Bay, and elsewhere on the Lower California coast. It is believed some very valuable information can be secured at these places, especially at Magdalena Bay.
 - d. The *Ortolan* is expected to be at the Mare Island Navy Yard on June 22.
5. *Detailed collecting instructions*:
- a. That the purposes of the expedition may be realized, it is essential (1) that very large collections of specimens be obtained in all departments and (2) that full and carefully prepared notes be kept. It is suggested that the various members of the party confer with reference to this matter and that a uniform system be agreed upon, so far as the diversity of subjects permits.
 - b. *Birds*: While ample collections will be made both of land and sea birds, special attention will be given to the land birds. As many specimens as possible should be secured of each species except in cases where the life of it would be endangered by so doing. A hundred specimens of a species is none too many.
Mr. E. W. Gifford very much desires a few live Socorro doves and every effort should be made to get them. Full directions will be supplied by Mr. Gifford. Notes on the actual and relative abundance of the different species, their habits, behavior, food and feeding habits, breeding habits, nests and eggs, enemies, etc., should be made. The weights of the larger birds should be recorded.
 - c. *Nests and eggs*: Collect in abundance. Prepare very carefully and make careful and complete records.
 - d. *Mammals*: A few specimens of every species and *many* specimens of small land mammals if there be any. A very careful and thorough search should be made for fur seals of which it is believed a few still remain about those islands, particularly Socorro. The caves should be explored thoroughly. Search should be made for fur-seal skulls. This is one of the most important investigations that can be made at these islands. Any data regarding whales and other cetaceans should be recorded in detail.
 - e. *Reptiles*: As many specimens as possible of every species should be collected and very full and careful notes taken as to their abundance, habits, etc., etc.

- f. *Fishes*: It is desired that large collections be made of every obtainable species, and that careful notes be made as to their abundance, distribution, habits, food value, etc. Any data that may be secured regarding the presence of tuna and other scombroid fishes in the waters visited will prove of value. Every specimen should be carefully tagged or labeled.
- g. *Mollusks and other marine invertebrates*: These constitute important desiderata; very extensive collections should be made.
- h. *Insects, spiders, scorpions, etc.*: There is no limit to the number of specimens desired in each group. Field notes on distribution, habits, etc., should be carefully recorded.
- i. *Botany*: Ample series of specimens of each obtainable species of plant (including phanerogams, vascular cryptogams, algæ (marine, freshwater and land), fungi, etc., should be preserved. Full ecological notes should be kept.
- j. *Meteorology*: Weather and climatic data—wind, rain, fog, temperature of air and water, ocean currents, etc., should be recorded. It is expected that Captain Nelson will arrange to have these observations made and properly recorded.
- k. *Geology and paleontology*: It is expected that you and Mr. Jordan will make a careful study in these fields on each island visited.
- l. *Photography*: Photography of animals, plants and general scenery will constitute an important part of the results of the expedition. These will include still and moving pictures of birds and other animals, plants, scenery, etc. Special attention should be given to the bird rookeries.
- m. Great care should be taken that the specimens of whatever kind collected shall be as perfectly prepared, preserved and authenticated as possible. In this matter every member of the staff should take special pride.
- n. Detailed collecting directions prepared by the respective curators are attached hereto.
- o. Finally, each and every member of the expedition must keep constantly in mind that the success of the expedition will depend largely upon observance of the following principles of conduct: (1) whole hearted interest in the success of the expedition as a whole, willingness and readiness to cooperate with and assist others, and patience and forbearance under difficult or trying circumstances; (2) courtesy and gentlemanly conduct at all times; (3) careful observance of rules of health; and (4) the taking of no unnecessary risks to life or limb, so that the expedition may return without any serious accident having occurred and with every member in excellent health and spirits.

DETAILED DEPARTMENTAL DIRECTIONS

For the Botanist, Mr. H. L. Mason

Collect mosses, hepatics, fungi, and algæ according to directions from Dr. W. A. Setchell. If possible make six or more sets of each.

In Phanerogams and vascular Cryptogams collect six sets or more when possible. Number each collection, keep record of date, place of collection, environmental conditions and notes of general appearances, color of flowers or any other noticeable peculiarities, so as to give a good general description in your report whereby the plant could be recognized in the field by an intelligent observer.

Collect seeds for planting as well as for specimens.

Dr. Rose of the National Museum wants good series of live specimens of every kind of cactus.

(Signed) ALICE EASTWOOD
Curator.

For the Entomologist, Hartford H. Keifer

As representative of the Department of Entomology it will be your duty first to collect insects of all orders, then the spiders, scorpions and myriopods, when that can be done without prejudice to the work on the insects. In collecting insects it is of first importance to secure as many species as possible and second, to take series. In collecting, watch for the varying ecological conditions and endeavor to cover all as fully as circumstances will permit. Where there are trees or bushes use the umbrella; if there be grass or suitable bushes use the sweep-net; where there are stones turn them or enough of them to secure their peculiar fauna; dead cactus stems can be turned or opened and some interesting forms will be found there. Many insects hide among rubbish at the base of trees or under bushes and cactus and can be raked out; loose stones about the roots of trees and cacti yield some good beetles. If there are flowers use the butterfly-net for insects frequenting them. Some good things are to be found under kelp and other drift along the sea shore, and sandy areas will yield interesting Diptera, Coleoptera and Hymenoptera, and possibly some Hemiptera. Should there be freshwater pools or streams look for aquatic insects of all orders. Dragonflies and grasshoppers will usually be taken with the butterfly-net. Dead wood can be cut for boring beetles. At night, work with the lantern will secure insects of many orders, and if practicable the trap-lantern and sugaring might be tried for moths. Your own judgment will tell you which method of collecting will be most productive in each locality. Notes on the food habits of the species can be placed in the boxes with the specimens or attached to their pins. Note in day-book or journal where work was done each day and any other items of interest regarding any species of insect taken. Be careful that correct locality, and especially date, be placed with each catch of specimens.

In preparing material for shipment pin up all moths except the micros which may be placed in pill-boxes; butterflies should be papered.

Diptera should be pinned in so far as possible, if large enough for No. 1 pins; those too small for these pins can be placed in pill-boxes for mounting on points. Place insects of other orders in pill-boxes, except certain beetles such as Tenebrionidæ, Carabidæ and some large smooth beetles and Staphalinidæ which should be put into alcohol, as should all spiders, scorpions and myriopods.

While collecting insects save for the other departments such land shells, lizards and snakes as you may capture without undue loss of time. In all your work take no unnecessary risks of accident by carelessness in climbing about cliffs or over rocks; a moment's carelessness might seriously cripple the work under your charge and seriously affect the whole expedition.

(Signed) E. P. VAN DUZEE,
Curator.

For the Herpetologist, Mr. Joseph R. Stevin

The following details are submitted as covering the work of the Department of Herpetology.

Every effort will be made to collect a very large series of lizards and all the snakes possible from Clarion Island, as specimens from this island are very rare in collections and a sufficient series should be obtained for various exchanges. It is also important to discover whether there is more than one species of lizard as reported by the Webster-Harris Expedition.

As the collection from Socorro Island is represented by only a small series of the one known lizard, it is important to increase this series in order to have sufficient material for comparison and exchange. As much night work as possible will be done in an effort to discover whether any of the nocturnal lizards and snakes found in the tropics inhabit the island. The higher elevations where so little work has been done will be given as much attention as possible.

As the department has no material whatever from the Tres Marias Islands, as large a series as possible of all the species found there should be collected. Particular attention will be paid to the smaller islets which often prove to be the best collecting grounds.

While all specimens possible will be collected on the stops made along the peninsula and adjacent islands, it is important to secure the species not in the Academy's collections at present and to secure larger series of some of the rarer lizards and snakes.

Ample field notes for work with the collections will be kept. Records will be kept of the localities and abundance of sea turtles and a sharp lookout kept for sea snakes which have been reported as far north as La Paz.

The policy of the department in general will be to secure sufficient material to have good series of all the species after a representative collection is donated to the United States National Museum and a sufficient number saved for exchange.

(Signed) JOSEPH R. SLEVIN
Assistant Curator.

*For the Ornithologists and Mammalogists
Mr. Frank Tose and Mr. J. T. Wright*

In addition to the general instructions for the work to be carried on during this expedition, the following detailed instructions are given:

While collecting specimens, the fact must ever be borne in mind that the National Museum and the Mexican Government each expects to receive a set of duplicates, and also that specimens of insular forms will have a high exchange value. In consequence, it is especially desirable to obtain large series of such forms and of all the shearwaters, etc., as well. If heretofore unrecorded species are encountered every effort must be made to obtain specimens thereof.

Juvenile and immature birds of any and all kinds are particularly desired, and a reasonably limited series of such should be secured when possible.

A few of the stomachs and hearts of specimens collected should be preserved in formaldehyde solution, with each stomach and heart tied up in a piece of cheese cloth, with the field number of the specimen on an attached label.

A few alcoholics of entire bodies should be made of as many species as space and opportunity may permit, but not, of course, at the expense of regularly prepared specimens.

It is possible that well-preserved skeletons or skulls of various species of birds or mammals may be found along the shores where there are beaches, and such should be preserved.

As far as can be done, birds and mammals secured should be made up into the usual study skins, but, when time will not permit of this, specimens that otherwise would be lost must be skinned and preserved with salt, with proper data attached, until the rush of work is over. Some skins of commoner species should be placed in a *brine pickle*, after being first well washed in freshwater to remove blood from feathers or hair.

Especial care must be taken to see that labels with the proper data are attached to each bird and each mammal collected, whether made up or salted. The labels furnished have upon them the field numbers, in chronological order, of the collector, and in addition to this must have the date of taking, the sex, the initial of the collector, all of which must be entered fully in the regular note book.

A reasonable number of sets of eggs of each species of bird should be collected.

Examples of the food of the different species of seed-eating birds should be saved and, when possible, specimens should be obtained of the trees or bushes from which came seeds found in the stomachs of birds. This is additional to the matter of saving crops or stomachs as before mentioned in these instructions.

Traps for mammals, on islands where such occur, should be kept set, and as many mammals obtained as opportunity permits; and, if time is pressing, these may be preserved in any manner that your judgment may suggest when it is impossible to make regular skins of them.

Some hearts of mammals should be preserved as well as those of birds.

As alcoholics of the smaller rodents (bats, mice, etc.) admit of softening and making over into skins, this method of preservation may be used in some cases, if there is space for such in the containers in use.

The bare parts of different species of freshly killed birds should be sketched in true colors by Mr. Tose.

As full notes as time may permit should be made of all matters of importance concerning abundance, habits, peculiarities, food, as far as observed and the habitat of the birds and mammals met with.

A thorough investigation should be made as to the presence of bats on islands favorable to the habits of these mammals, whether heretofore recorded from such islands or not. If present, every effort must be made to capture as many specimens as may be possible. When captured alive they may be kept in this condition for a number of days and prepared as specimens when time permits.

(Signed) JOSEPH MAILLIARD,
Curator.

*For the Paleontologists and Ichthyologists
Dr. G. Dallas Hanna and Mr. Eric Knight Jordan*

The Department of Paleontology will be represented on the expedition by G. Dallas Hanna and Eric K. Jordan. It is expected that at every stop where fossils of any kind are preserved, ample collections will be obtained. Since there are no known deposits of this character on Guadalupe, Alijos Rocks or any of the Revillagigedo Islands and none will likely be found, special study should be given to other phases of geology, particularly the volcanism which has produced the islands and its bearing on adjacent bodies of land. The distribution of land animals and plants on oceanic islands is due, at least in part, to phenomena belonging in the province of geology and special study should be given to place yourselves in a position to be able to give expert advice on this problem to students in the other branches. Sufficient collections of rocks should be made so that identifications can be made of any which may be later discussed in detail.

It is reported that there are deposits of fossils on the Tres Marias Islands which will be visited. If these are found, as complete collections as possible should be obtained. The same applies to any places on the peninsula or adjacent islands of Lower California. Since it is expected that stops will be made at several places on the way north, possibly enough of value will be obtained to offset the lack of fossils and it is expected that many species new to science will be brought to light.

In the collection of marine mollusks many other invertebrates will inevitably be secured. These should be preserved with as great care as possible.

It is expected that the members of this department will give considerable attention to the collection of fishes wherever stops are made. These,

as well as the marine invertebrates, should shed much light on the former history of the islands and the currents of the waters surrounding them. Reasonable care must be exercised in the selection of specimens to be preserved. It is desired that a sufficient number should be kept of each species to determine the distribution and to enable the identification to be made; rarities should be obtained in quantity. Fishes too large to be preserved in the containers provided should be measured, weighed and photographs of them taken. In some cases fins, heads or other parts can be preserved for identification.

Tanks have been provided for the transportation of live fishes for exhibition in the Steinhart Aquarium. These should be filled before departure from tropical waters and as many specimens as possible brought back alive. A good supply of sea horses in particular, is greatly desired.

It is expected that Dr. Hanna will take most of the official photographs on the expedition with still cameras. He should be prepared to photograph interesting or desirable specimens in all groups which may be needed for future illustration or which may be called to his attention by the other collectors.

In the motion picture work he will be assisted by Mr. Raymond Duhem who accompanies the expedition for this particular purpose. Every possible opportunity should be afforded for Mr. Duhem to secure a valuable and interesting series of films.

Make stops and observations wherever and whenever you think results of interest may be obtained.

No private collections are permitted. All specimens must be brought to the Museum from which distribution will be made.

No interviews are to be given out except by or through you and the Captain.

Very respectfully,
BARTON WARREN EVERMANN,
Director.

ITINERARY

It was contemplated that the expedition would be out a little over two months, April 15 to June 22. My own connection with the Geological Department of the Pacific and Associated Oil Companies as Microscopist was such that Mr. J. A. Taff, Chief Geologist permitted my absence for the period indicated. Practically nothing was known previous to our visit of the geology and oil possibilities of many of the places where we expected to call. Through the kindly interest taken in the work by Mr. F. B. Henderson, Vice President of the Associated Oil Company, a supply of gasoline for the small, detachable boat engine was furnished without cost.



The exceptional facilities afforded by the *Ortolan* and the willingness of the Navy Department to cooperate in every way possible made it seem desirable to visit a few other places than the Revillagigedo Islands. Full details and reasons will be found set forth in later pages and it will suffice here to enumerate the points visited. They are: Guadalupe Island; Alijos Rocks; Revillagigedo Islands; Tres Marias Islands; Mazatlan; Cape San Lucas; Magadena Bay; San Bartolome Bay; Cedros Island; and San Quintin Bay.

DATE	LOCALITY	ARRIVED	DEPARTED	REGION VISITED
APRIL 15	San Francisco.....	.....	1.00 PM	.....
17	San Diego.....	8.00 AM	.....	.....
18	San Diego.....	.....	1.00 PM	.....
19	Guadalupe Island.....	2.30 PM	.....	Northeast Anchorage and South end
22	Guadalupe Island.....	.....	10.00 AM	.....
24	Alijos Rocks.....	8.00 AM	11.00 AM	.....
26	Clarion Island.....	7.30 AM	.....	Various parts
MAY 1	Clarion Island.....	.....	5.00 PM	.....
2	Roca Partida.....	8.00 AM	11.00 AM	.....
2	Socorro Island.....	4.00 PM	.....	Various parts
12	Socorro Island.....	.....	2.00 AM	.....
12	San Benedicto Island..	5.30 AM	5.00 PM	.....
13	Maria Madre Island..	6.00 PM	.....	.....
14	Maria Madre Island..	.....	.....	Established shore camp
15	Maria Madre Island..	.....	.....	<i>Ortolan</i> left for San Diego at 9.30 AM
19	Maria Madre Island..	.....	5.30 AM	.....
19	Magdalena Island....	7.30 AM	.....	.....
22	Magdalena Island....	.....	6.30 PM	.....
22	Maria Madre Island..	8.30 PM	.....	.....
23	Maria Madre Island..	.....	.....	<i>Ortolan</i> arrived from San Diego at 1.30 PM
24	Maria Madre Island..	.....	2.00 AM	.....
24	Isabel Island.....	6.00 AM	5.00 PM	.....
25	Mazatlan.....	9.00 AM	.....	.....
27	Mazatlan.....	.....	7.30 PM	.....
28	Cape San Lucas.....	2.00 PM	4.30 PM	.....
29	Magdalena Bay.....	11.00 AM	.....	.....
30	Magdalena Bay.....	.....	7.00 PM	.....
JUNE 1	San Bartolome Bay...	9.30 AM	.....	South side
3	San Bartolome Bay...	.....	4.00 AM	North side
3	Cedros Island.....	9.30 AM	.....	Bernstein's abalone camp
5	Cedros Island.....	.....	.....	Center of east side
6	Cedros Island.....	.....	1.00 AM	.....
7	San Quintin Bay.....	3.00 AM	.....	Across plain to Santo Domingo
8	San Quintin Bay.....	.....	5.00 AM	.....
8	San Martin Island....	7.00 AM	2.00 PM	.....
9	San Diego.....	8.45 AM	.....	.....
10	San Diego.....	.....	7.00 AM	.....
12	San Francisco.....	.....	6.30 PM	.....

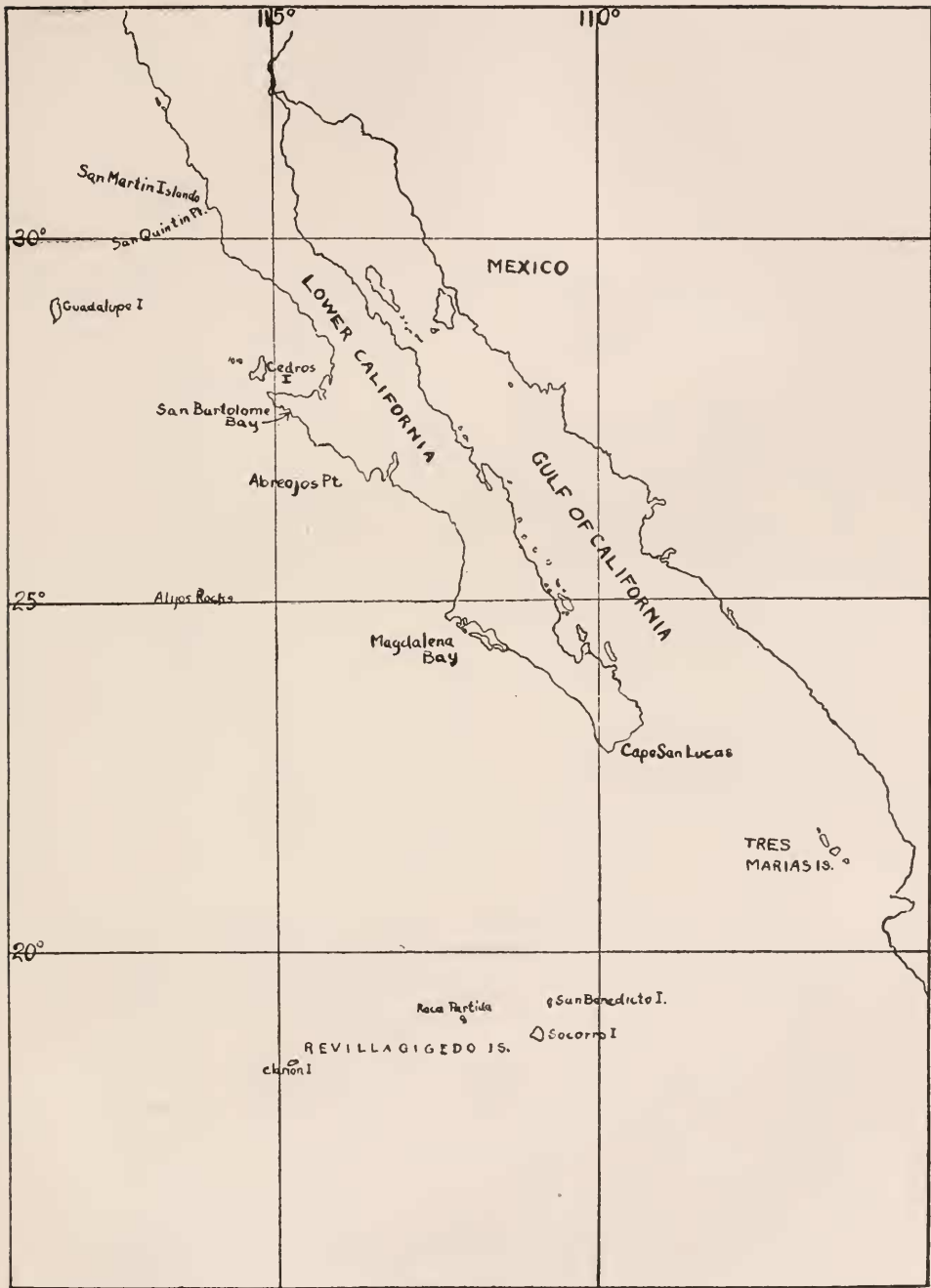


Fig. 1. Sketch map of region west of Mexico visited by the expedition of 1925.

March 30, 1926

The general region visited is covered by the map herewith (fig. 1) and detailed island charts are found in appropriate places in the text. These have been taken from the charts published by the U. S. Hydrographic Office.¹

The charts to which special reference is made in the work of the present expedition are as follows:

<i>Title</i>	<i>Chart Number</i>
Cape San Lazaro to Cape San Lucas.....	621
Revillagigedo Islands.....	622
(Tres Marias Islands).....	622
General West Coast Sailing Chart.....	1006
General West Coast Sailing Chart.....	1007
Mazatlan Harbor.....	1024
San Quintin Bay and approaches.....	1043
San Diego to San Quintin Bay.....	1149
San Martin Island to Cedros Island.....	1193
San Bartolome Bay.....	1204
Abreojos Point to Cape San Lazaro.....	1493
Magdalena Bay.....	1636
Cape San Lazaro to Cape San Lucas.....	1664
San Lucas Bay.....	1666
Guadalupe Island.....	1681
Hassler Cove.....	1686
Roca Partida.....	1687
Alijos Rocks.....	1687
Socorro Island.....	1687
San Benedicto Island.....	1687
Clarion Island.....	1688

NEW GEOGRAPHIC NAMES

During the progress of the expedition it was found that some physiographic features of considerable importance were without names. Some of these will be referred to on later pages of this report and others will appear in the technical reports. In order that the new names which we proposed to bestow might receive official sanction before their adoption by us, Mr. C. E. Grunsky, President of the Academy, addressed the following letter to the Ambassador of Mexico at Washington.

¹A full list of the charts published by the Hydrographic Office of Western Mexico and Central America may be found in the publication "H. O. No. 84 Mexico and Central America Pilot (West Coast)" sixth edition, Washington, Government Printing Office, 1920, and the supplement to the same published in 1923.

SAN FRANCISCO, CALIFORNIA,
November 14, 1925.

SEÑOR DON MANUEL C. TELLEZ,
2829 Sixteenth Street, N. W.,
Washington, D. C.

My Dear Sir:

In 1922 and 1925 the California Academy of Sciences sent expeditions out to explore certain islands off the west coast of Mexico. In each case most pleasant collaboration was enjoyed with scientific representatives of your country. The islands had not previously been very well explored and in the preparation of the scientific reports on the collections obtained, we find we need names for a few important topographic features which have heretofore been without designation.

The names which have been proposed for adoption by our scientists and which meet the approval of the Academy, are listed below with some information pertaining to each one. They have all been entered in red ink on copies of the U. S. Hydrographic Office charts which have been mailed to you today, under separate cover.

Angulo Rock.—This name is proposed for a small, outlying, flat-topped rock immediately northeast of Asuncion Island, Lower California. It is named in honor of Captain Victor Angulo, in 1922 Commander of the Fisheries Patrol Boat *Tecate*, now Commander of the Mexican National Patrol Vessel *Presidente*. Several species of insects entirely new to science were collected on this rock and a name for it is badly needed.²

Mount Gallegos.—This name is proposed for the highest mountain on Clarion Island of the Revillagigedo Group. Chart No. 1688 (U. S. Hydrographic Office) gives the elevation as 1100 feet. The name is proposed to honor the late Professor José M. Gallegos, an indefatigable explorer for the Government of Mexico, and whose recent death in British Honduras is sincerely mourned by all who knew him. Prof. Gallegos was a member of the party which, in 1925, explored the mountain for which his name is proposed.

Mount Evermann.—This name is proposed for the central peak of Socorro Island of the Revillagigedo Group. It has been selected in honor of Dr. Barton Warren Evermann, the distinguished Director of the California Academy of Sciences and the organizer of so many expeditions in which this institution has actively cooperated with the Government of Mexico.

Grayson's Cove.—This name is proposed for the little cove at the west end of Cornwallis Bay, Socorro Island, as shown on the U. S. Hydrographic Office Chart No. 1687. It was in this cove in 1867 that Colonel A. S. Grayson's sloop was wrecked and where the only known supply of fresh water on the island is found. It is suggested that beneath the name and in parenthesis the words "Fresh Water" be printed on United States' charts and "Aqua dulce" on those printed in Mexico. The account of the

² See Hanna and Anthony, National Geographic Magazine, Vol. 44, July 1923, p. 95. Hanna, Proc. Calif. Acad. Sci., Vol. 14, No. 12, 1925, p. 261. Blaisdell, Proc. Calif. Acad. Sci., Vol. 14, No. 14, 1925, pp. 321-343.

wreck and discovery of the spring may be found in Proceedings of the Boston Society of Natural History, Vol. 14, 1871, pp. 288-290.

Point Old Man of the Rocks.—This name was given by Colonel Grayson to the point of rocks which formed the eastern boundary of the little cove herein proposed to be called "Grayson's Cove."

Ash Heap.—This name is proposed for the highest elevation on San Benedicto Island. It is at the south end of the island, 975 feet high, and is composed almost entirely of soft volcanic ashes. It was explored by the expedition of 1925.

Herrera Crater.—This name is proposed for the central peak of San Benedicto Island indicated on U. S. Hydrographic Office Chart No. 1687, as being 683 feet high. The name is selected in honor of Prof. Alphonso Herrera, the distinguished Director of the National Museum of Mexico who took a large part in the organization of the expedition of 1925 which explored the island. The crater is one of the most perfect the explorers had ever seen.

Before the above names are adopted by the United States and used in our maps and in our scientific reports, it is very desirable that they receive the approval of the Government of Mexico.

Our reports are almost ready to be printed; therefore, it will be a great favor to the Academy if due consideration of the subject may be given by you at an early date and, if approved, you will be kind enough to advise The Secretary, U. S. Geographic Board, Washington, D. C.

With sentiments of highest respect, I have the honor to be, my dear Sir,

Your obedient servant,

(Signed) C. E. GRUNSKY,
President.

In due time Señor Tellez advised by telegraph that his government had approved the proposed names.

C. E. GRUNSKY,
President, California Academy of Sciences,
San Francisco, California.

Have received communication from Mexican Government approving the geographical names Revillagigedo Islands proposed in your letter of November 14.

MANUEL TELLEZ,
Mexican Ambassador.

Copies of the above correspondence having been furnished to the U. S. Geographic Board, the U. S. Coast and Geodetic Survey, the National Geographic Society, and the U. S. Hydrographic Office, it is expected that the proposed names will be incorporated in future issues of maps and charts of the region.

NARRATIVE

April 15 to 17—The *Ortolan* with all of the party, except Messrs. Contreras, Gallegos, Jordan, Solis and Hanna, left Mare Island Navy Yard in San Francisco Bay at one in the afternoon of April 15. Mr. Jordan and I reached San Diego the next evening. The ship arrived on the morning of the seventeenth at eight o'clock and immediately went to the Destroyer Base where the installation of a second refrigerator machine was begun at once.

The placing of this machine on the ship was done at the suggestion of the Academy and was primarily for the benefit of the Department of Ornithology. It was foreseen by all that Messrs. Tose and Wright would have great difficulty in preparing all of the specimens of birds and eggs in standard museum manner which could be profitably taken on the cruise. To do so each specimen of sea bird would require at least one hour of straight taxidermy and it was believed that any arrangement which would lessen this time would enable a larger collection to be obtained.

The officials of the Navy Department deserve the highest commendation for the readiness with which they undertook the installation of the refrigerator because it involved a very considerable amount of trouble. It was placed on the right side of the after deck and proved to be one of the greatest aids to bird collecting ever taken into the tropics. Specimens in large numbers were taken in favorable places and with the excellent working facilities already provided for the purpose, preparation of the specimens could proceed at any time, even days or weeks afterwards. As a matter of fact a large consignment of birds and eggs was sent to San Diego when the vessel had to replenish fuel on May 15, and was there transhipped to San Francisco in cold storage. Likewise on the final return of the *Ortolan* the refrigerator was filled with unprepared specimens. The equipment undoubtedly enabled the party to bring back some hundreds of specimens which could not have been collected at all had it been necessary to complete the taxidermy work in the field. So successful was the venture that it seems to me every expedition which can possibly do so should be equipped with cold storage facilities.



April 17—April 17 at San Diego was spent in assembling a few additional supplies such as nitrogelatin for use in the collection of fishes. An assortment of bottles, thermometers and nets was placed on board by the Scripps Institution for Biological Research at La Jolla, California; these were to be used in the collection of a series of samples of water and surface plankton as was done by the Guadalupe Expedition of 1922.³ This work was continued until we reached Clarion Island, after which it was found impossible to detail any member of the party to it without unduly hampering other assigned duties.

April 18—On April 18, the installation of the refrigerator having been completed the previous evening, the ship was moved to La Playa, the Navy coal and oil station near Point Loma, San Diego Bay. All who were on shore joined the vessel there and at 1 p. m. departure was taken for Guadalupe Island. Before leaving Mr. Lawrence M. Huey of the San Diego Society of Natural History took a photograph of the party on the dock. (See plate 1.)

April 19—The sea became very rough during the night of April 18 and a very uncomfortable time was spent by all; many of the party were seasick. Our quarters on the bridge deck had been enclosed and covered with canvas by the Naval officials at Mare Island, but even with the excellent facilities provided some of the heavy seas broke over the top and wet some of the supplies. Fortunately the mine-sweepers of the *Ortolan* class are exceedingly seaworthy and many a larger vessel would have been more uncomfortable in the weather which prevailed.

This first night out proved to be the worst of the entire cruise, and we were all glad to get in the lee of Guadalupe Island; anchor was cast at 2:30 p. m. under the towering lava cliffs at Northeast Anchorage.

The object of our visit to Guadalupe Island was to obtain a census of the herd of elephant seals for comparison with counts of previous years and also to secure an additional series of motion pictures of these strange beasts of the sea. In 1922 we had visited the herd in July after all the animals except the males had left the beach, but by making this early trip we had

³ See Hanna, Proc. Calif. Acad. Sci., 4th ser., Vol. 14, No. 12, 1925, p. 226.

hopes of getting some data on the breeding habits of the species. It was also expected that the collectors would be able to add greatly to the collections from this island by this early visit, particularly in the groups of plants, insects, fishes and birds, all of which could progress while the work on the elephant seal beach was being carried on. Therefore, we had planned to establish a camp on shore at Northeast Anchorage.

Soon after we reached that place, a landing party went ashore for a short time. A fierce gale was blowing directly off shore and the high precipitous mountains and cliffs produced swirling eddies of wind of almost tornado violence. Clouds of spray were actually picked up from the surface of the sea and scattered hither and yon. When one of these sudden gusts of wind, known in the sailors' parlance as a "will-a-waw" the world over, would strike the ship it would surge violently against the anchor or swing suddenly from side to side. At this point a vessel must come in very close to shore in order to get "holding bottom" on account of the great steepness of the submarine slopes of the mountain. A projecting lava reef adds to the dangers of the place. Under the circumstances Captain Nelson very wisely considered the anchorage unsafe for the night and those who had landed were called back.

With the wind which was blowing there was only one possible place to stay at anchor at Guadalupe and this was at South Bay. Investigation showed that here the ship would be very safe and comfortable as long as the storm continued from the northwest, and the anchor was dropped late in the evening, too late for further shore work on the 19th.

At Northeast Anchorage it was noticed that the goats were just as abundant as in 1922. The lowlands were quite green with new vegetation showing conclusively that some rain had fallen at no very distant date. However, as we sailed down the east side of the island the landscape became progressively more barren and at the south end it was as parched as any desert could be.

Professor Gallegos told us that the soldiers who had been stationed at the Northeast Anchorage had been removed a few months prior to our visit owing to transportation difficulties, but that as soon as a vessel, for which negotiations were in progress, was secured it was expected that they would

be returned. It will be recalled that as a result of recommendations made by the members of the expedition of 1922 the President of Mexico declared Guadalupe Island a government reservation. The soldiers had been stationed there to enforce the regulations which had been prescribed and from all we could learn they have performed their duty well.⁴

During the evening of April 19 three murrelets and a shear-water flew aboard the ship, attracted by the lights. And over the side, around a submerged light brought for the purpose, a very considerable number of fishes was taken for the collection.

April 20—The gale continued all night from the north-north-west with full force and there was no indication that it would cease soon. At daybreak it was evident that a landing on the elephant seal beach would be impossible at that time and other plans were made accordingly.

Early in the morning Messrs. Slevin, Jordan and I visited the old South fur seal rookery but found no seals. We landed for a short time and collected some insects, shells and plants and on the way back across South Bay to the ship we made four successful dredge hauls from sandy bottom.

At 10 a. m. we sailed for Northeast Anchorage again and landed Messrs. Tose, Mason, Wright and Keifer, equipped to spend the night on shore. They set out at once up the cañon back of the barracks for the top of the island, although the weather was very threatening and a fierce, cold wind was blowing.

The rest of the party returned with the ship to South Bay for the night. The motor boat was launched upon arrival and about 20 men of the crew went ashore at the old rookery for "liberty." Messrs. Slevin, Jordan, Musser and some of the crew collected fishes on the lava reef but had poor success on account of the high surf which was breaking. Professor Gallegos secured a few birds and Señor Solís secured some plants, one being a cactus of the genus *Mammillaria*, the species being the same as I had found at the same place in 1922.

Captain Nelson, Mr. Duhem and I went with the motor boat around Inner and Outer Islands. Some pictures were taken of these remarkable rocks. Inner Island is composed largely of

⁴ See Hanna, Proc. Calif. Acad. Sci., Vol. 14, No. 12, 1925, pp. 232-233.

a yellow volcanic sand with a cap of black lava and several dykes extending downward from it to the water line. The walls are sheer and landing is impossible. There is a little vegetation on top but with the field glasses we were not able to make out any species except a "cholla" similar to the one that grows on Guadalupe.

Outer Island is composed wholly of lava and inside there is a bowl-shaped crater containing water. A shelf of rock on the west side affords a possible place to land in calm weather, and from it a person might climb over the rim to the inside; we could not attempt it with the sea running as it was that day. On a narrow shelf just above the surf on the south side of the island 34 California sea lions were found. Cows and bulls were present but no pups. We suspected that the water on the inside of the crater might be fresh because the slopes of the walls afford a considerable drainage area. These are composed of hard black lava weather-cracked all over, giving the appearance, suggested by Captain Nelson, of a railroad map of Illinois.

At 5:30 p. m. the Captain picked up all of the men who had landed except six who were inland away from the beach without water or food and poorly clad. Naturally we felt considerable anxiety for them and at 9 p. m. Captain Nelson and I with one member of the crew started with the "dinky" for the landing to see if they had arrived. When halfway there we saw the light of a fire they had started inside the walls of one of the old Russian sealer's houses but it took us nearly an hour to get there from the ship against the gale of wind. All of the men were safe. They had captured a young black kid which they brought on board for a mascot. (Next day they tried to kill the fleas on it with creosote, and killed the goat also.)

Many showers of rain fell during the afternoon and continued in increased quantity into the night. During one squall we had a fine rainbow, the ends of which almost met in a circle in our boat.

April 21—I think fully half an inch of rain fell where the ship was anchored during the night, undoubtedly a very considerable amount for this section of the island. It is to be

regretted that two or three weeks later we might not have been able to make another visit for the benefit of the botanists—desert plants, as a rule, respond very quickly to showers and Guadalupe Island should be no exception in this respect.

We had fully intended to get under way at 5:30 a. m., but the north-north-west gale continued and we knew it was useless to try to land on the elephant beach. Therefore, we remained at anchor on good sand bottom at South Bay for most of the day.

Messrs. Jordan, Duhem and I went with the skiff and demountable engine along the eastern shore where we could remain close in under the cliffs for protection from the wind. Our object was the collecting of fishes and we were very successful in this. Some taken were allied to genera found only in tropical waters although the water at Guadalupe Island was 61° F.

We were on the way back to the anchorage when the *Ortolan* was seen coming around one of the headlands, so we joined her at sea and proceeded directly to Northeast Anchorage. There we found the shore party on the beach ready to come aboard. In rowing in for them I found it almost impossible to make headway when a "will-a-waw" struck us. Once the boat was spun around and headed in exactly the opposite direction I wished to go and that against a back-watered oar.

Messrs. Tose, Mason, Wright and Keifer had a hard trip overland. They did not reach their objective, the cypress grove on top of the island, owing to fog and rain, but chased a dozen or more goats out of a lava cave and camped there for the night. One of the animals furnished food and fuel was secured from a nearby oak tree. Most of the night was spent cooking goat meat, drinking tea and recalling the comforts of civilization, but they returned with an excellent collection of birds, insects and plants. Among the latter were some ferns and other species not previously recorded from the island.

The anchor was dropped at Northeast Anchorage but it would not hold the ship in the violent wind eddies, so we returned to South Bay for the night.

April 22—The incessant wind continued unabated throughout the night and on the morning of April 22 we gave up all hope of being able to take the census of the elephant seals. Landings were so very difficult to make, even on the lee shore and travel to the highlands so nearly impossible that all of us thought we would better proceed to the main objective of the expedition, the Revillagigedo Islands. Therefore, at 10 a. m. the ship was headed in the direction of Clarion Island 660 miles distant and the westernmost of the group. Guadalupe Island was hardly out of sight when we entered calmer seas and less wind; this seemed to indicate what we had already come to suspect—that this huge volcanic mass rising from deep waters is its own storm center.

April 23—We continued to take water and plankton samples throughout the day as the ship proceeded southward. The course was laid so that we would pass close by Alijos Rocks and we expected to sight them at noon, but a low-hanging haze prevented their being found before dark. The rocks themselves are not high and therefore are not visible from any great distance, but Captain Nelson was anxious to get a check on his instruments and we were likewise anxious to investigate the animal life about them. Therefore, after he had determined the position of the ship by star sights, we steamed ahead slowly during the night.

Very little life of any kind was seen during the day. Two blue-faced boobies, two petrels of some kind and some flying fish comprised the total.

April 24—Alijos Rocks were sighted at 6:30 a. m. and at 8 a.m. while the ship lay to, Messrs. Wright, Jordan and I rowed in as close as we could safely, to make collections.

The group consists of three main rocks, North, South and East, all volcanic in origin. All are pinnacles with vertical or overhanging walls. North Rock is 72 feet high, slopes steeply to the eastward on top, like a roof and is about 25 feet in diameter.

South Rock, the largest of the group, is 112 feet high and about 35 feet in diameter. It stands on five legs, the sea having eaten away the remainder of the base. On the south side

there is a large rock, just awash on which a seal might land in calmer weather than we saw. Between North and South Rocks, a distance of about 150 yards, there is a reef, just awash. This forms a barrier over which the northwest swells broke with tremendous violence.

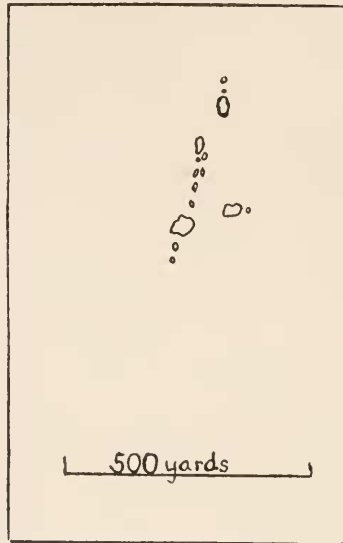


Fig. 2. Alijos Rocks.

East Rock is 60 feet high and about 30 feet in diameter. Its top is jagged and has two lava pinnacles. South of it but close by there is a rock just awash.

The three main rocks form an approximately equilateral triangle with shallow water enclosed between. Shoals also extend about 100 feet to the south of East Rock.

In this shallow water we succeeded in placing six shots of dynamite and got five species of fishes. All but one had tropical Indo-Pacific affinities. One other species was taken on a line from the ship and ten miles to the north of the rocks we caught an ocean bonito. A few seaweeds which came up from the shots were collected.

Mr. Wright succeeded in shooting and recovering 13 birds. East Rock had only sooty terns on it and it is probable that they nest there. South Rock had sooty terns and blue-faced

boobies. North Rock had red-billed tropic birds and blue-faced boobies. Both appeared to be nesting but positive proof could not be obtained.

Not a plant of any kind could be seen on the rocks. It is not likely that seals ever stop at the place and except for the birds enumerated and a limited fauna and flora of marine animals and plants, they are excessively barren. Very unfortunate indeed would be the ship which would run aground upon them; we could not find a single place where a man could scramble on shore, even in calm weather.

We left the rocks at 11 a. m. on the course for Clarion Island and took water samples to 6 p. m. After leaving Alijos, the atmosphere suddenly became warmer, the sky cloudless and only a gentle tropical breeze was blowing. From Guadalupe to Alijos the water gradually became warmer from 61° to 67° and south of the latter it became warmer still.

April 25—On the way to Clarion Island, all hands were busily engaged in making preparations for work immediately upon arrival. A final overhaul was given to equipment in general and everything possible was done in advance to facilitate collecting operations the moment we arrived at this distant, westernmost outpost of Mexico's possessions.

April 26—When we looked to the southward at dawn we could see directly ahead, the black forbidding cliffs on the north side of Clarion Island. Some little trouble with the machinery made it necessary for us to stop the engines and drift for a little while when we were still about three miles away and this gave us an opportunity to glimpse the wonderful array of marine life which swarmed all about. Man-o-war birds by hundreds sailed gracefully out to inspect us while boobies constantly passed back and forth from their feeding grounds and rookeries. In the sea, sharks, porpoises, whales, and flying fishes were frequently seen. Soon after we started, a school of giant swordfish carried away all of the trolling gear we had out, with no more concern than if our lines had been spider webs.

The anchor was dropped in Sulphur Bay on the south side of the island at 7:30 a. m. and collecting began at once. No

sooner had the ship come to rest than hand lines over the side began pulling in fishes of various kinds.

A compliment must here be paid to the personnel of the *Ortolan* for the very efficient manner in which both ship and boats were handled throughout the cruise. On a great many occasions it was demonstrated that they were thorough masters of the machines they operated. For instance, it was very

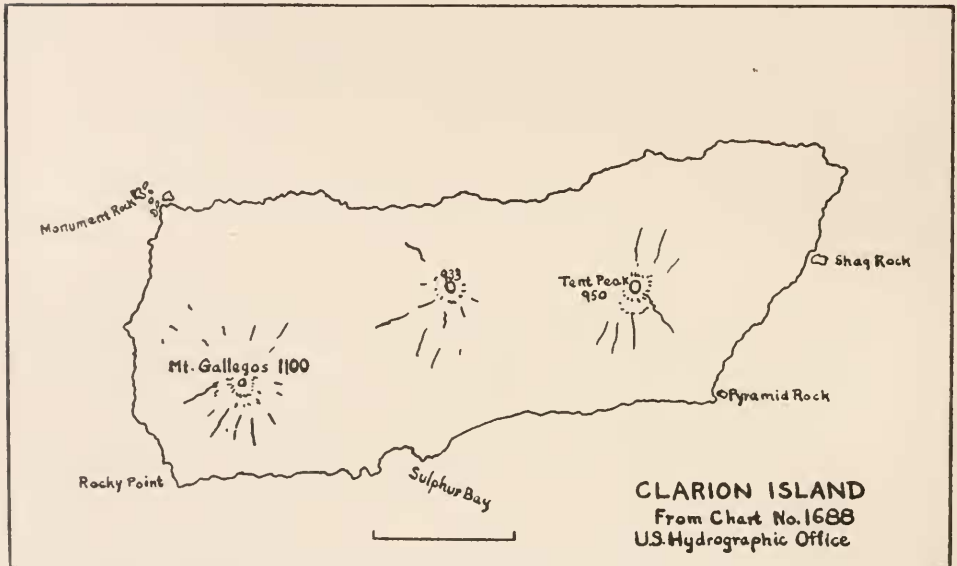


Fig. 3. Clarion Island.

seldom indeed that more than two minutes would elapse after the anchor was dropped until motor boat and row boat were in the water and the engine of the former started and ready to go.

Sulphur Bay is named for the British Survey ship *Sulphur*, which cruised in west Mexican waters at an early date. The landing place, marked on the Hydrographic office chart, is located on a lava wall in a narrow tongue-shaped indentation of the shore line just west of the coral beach about one-fourth mile. Except in favorable weather the beach is unsafe on account of the surf and, while we did land there many times before we left, our first party was put ashore at the indicated

place. This was soon after we had anchored and the party consisted of all of the scientific staff, except those to be mentioned later, and some of the members of the crew of the *Ortolan*.

Sr. Gallegos and I were very anxious to learn if there be any truth in the rumors we had received from time to time that fur seals were found on Clarion Island. It seemed desirable to investigate the matter as soon as possible after our arrival so that in case none was found, this could not be attributed to any disturbance caused by our presence. Therefore, we set out as soon as the landing party was on shore, with Captain Nelson, Chief Engineer Lot and Mr. Musser in the motor boat. We went completely around the island on the trip and examined the shores from as close as it was feasible to go with the boat. We never saw a seal of any kind, and no shore line which appeared to be very favorable rookery ground exists on the island. In view of the fact that no seals were seen at all during our stay at Clarion, it seems safe to conclude that they are absent.

It must not be assumed from this that our trip around the island was lacking in interest. Several humpback whales were seen at close range and hundreds of sharks and porpoises were noted. About 30 green sea turtles were observed, two males having been captured and put aboard the ship before we started. These were later used for food but it must be said that they did not appeal strongly to any of us. With a good supply of fresh meat in the refrigerator and excellent fish swarming all about, and to be had on a moment's notice, the turtles were not needed and we molested them no more on the trip.

Much of the way around the island we passed over growing coral reefs and for several of us it was our first opportunity to witness this magnificent sight. As usual the chief objects to attract attention were the gaily colored fishes, moving jewels in an azure sea. The Captain and Messrs. Lot and Musser used the trolling lines until their hands were sore from pulling in the fishes. Those most in evidence in the catch were two species of caranx and a large speckled form allied to the bass.

One of the caranx was a most brilliant blue trimmed with lemon-yellow.⁵

Passing close under the northern cliffs the Clarion Island doves were often seen passing from point to point while high up on the crags man-o-war birds and boobies were resting complacently. Occasionally a red-billed tropic bird would fly swiftly overhead, the long streaming tail feathers so resembling the "marlin spike" that sailor-men call it "bosun bird."

When the party assembled that night on board ship there was much to be told of the experiences during the day. Those on shore had the pleasant (or unpleasant) task of cutting trails with machetes through the otherwise impenetrable thickets of cactus and vines. A species of *Opuntia* similar to the common cactus known as "prickly pear" grows very luxuriantly in a broad zone around the shore line and more or less in patches to the top of the island. Intertwined in it everywhere are dense growths of vines. We had been forewarned of this condition, fortunately, and had provided long knives to aid in making trails. But even with the best that could be done in this line every one received many painful thorns before the work on the island was finished.

Messrs. Mason and Solis returned to the landing heavily laden with plants. They had found collecting exceptionally good although it was very evident we were on hand during the dry season. Very few annuals were to be had and the most of the vegetation had the appearance of late fall in a temperate climate. This condition indicated that August to November would be the best months for a botanist to visit the island.

Many of the perennial plants were in bloom, nevertheless. One of the most conspicuous was a brilliant, blue morning-glory which grew in greatest profusion. Three species of beans were collected, one of which seemed to do so well in spite of the dry season that it should prove a desirable addition to the list of agricultural products in those sections where there are pronounced wet and dry periods. Seeds of almost all

⁵ At the time of writing, the collection of fishes has not been entirely identified; therefore, I am not able to give names of species found. The reader who may be interested in the subject is asked to consult the report on the fishes which is expected to follow this without great delay.

plants in fruit at the time of our visit were brought back for study and experimentation.

Mr. Slevin found only two species of land reptiles on the island, a snake and a lizard. He proceeded to make his collection forthwith because, although both had been known before from a very few specimens, they were practically unrepresented in the museums of the world. He wished to secure enough to supply this deficiency, at least in part.

One question every one asked but no one could answer was: "How did the snake and lizard ever get to Clarion in the first place?" The original stock could not possibly have gotten there by swimming the 500 or more miles of intervening water to the mainland. It seems equally incredible that they could have lived on a floating object long enough to have made the passage. That they were introduced by man is unthinkable; there is too much other life in the same category. No bird would be likely to carry these reptiles as passengers. The most plausible suggestion we heard made was that when they arrived there was intervening land where there is water now. This theory is not in conflict with the known geologic data.

No mammals of any kind were found on the island. Fortunately, the place has never been inhabited, even by temporary residents; hence those curses of isles to the northward, mice, cats and goats, have not become established. In fact, Clarion Island is one of the few places remaining which has not been modified in some way through the agency of man. The original "balance of nature" still obtains. We know of only one case of the introduction of any kind of life. In 1903 the California Academy of Sciences sent an expedition to these islands and during the course of work on Socorro Island some parquets were captured alive. Mr. E. W. Gifford, a member of the expedition, told us that some of these birds were liberated on Clarion Island. We saw no sign of them during our stay and it is supposed that they perished through lack of fruit which constitutes their chief food on their native island.

Mr. Keifer took a great many insects during the day on shore and there is little doubt that most of the species will be found to be new to science. He is the first entomologist ever to set foot on the island.

March 30, 1926



Mr. Jordan worked along shore, about the lava cliffs and on the coral reef. A large collection of mollusks, some fishes and other life was the result. Messrs. Tose and Wright found many birds to interest them. The resident forms of land birds are a species of wren, a ground owl, a dove and a raven. Brewster's and blue-faced boobies nest in large numbers and red-billed tropic birds are present but not common. The man-o-war birds were found resting on the cliffs and in the cañons in large numbers but no nests were observed during our stay. Turnstones, curlews and wandering tattlers, all migrants, were collected and Mr. Tose saw a single western gull.

Huge ocean swells whipping around both ends of the island made disembarking from the rock wall very difficult and in getting aboard the skiff, Mr. Wright dropped his shotgun overboard. Efforts of Mr. Duhem to recover it by diving were unsuccessful and it was feared that this serious loss at the beginning of the trip would be a great handicap. But next day Captain Nelson, always resourceful, got out a diving apparatus which was carried aboard the *Ortolan* and the bosun's mate went down safely and recovered the gun. It apparently suffered no injury.

April 27—Most of the party worked on shore in spite of the fact that a greatly increased sea made landing very difficult. Mr. Mason covered the west end of the island pretty well and collected about 60 species of plants. He went to the top of Mt. Gallegos, the highest point on the island (1100 feet), but found practically the same character of vegetation there as at sea level. There are evidently no altitude zones of life on Clarion.

The island is about five miles long, two miles wide and is divided by passes into three separate hills. All rocks and cliffs seen are volcanic. The hills are rounded by erosion and there are few cañons worth noting. Over most of the island there is deep reddish brown soil, all indicating a very considerable geologic age. In gathering trash from beneath the bushes to be brought back to the museum for the purpose of picking out the land shells, a few fragments of fossil-bearing rock were unwittingly collected. The matrix has the appearance of a hard, calcareous clay-shale and it is believed from this and the

few fossils taken that the rocks are at least as old as Pliocene. The specimens were obtained on the sloping land immediately back of the landing place where all exposed rocks are volcanic.

The largest bushes are not over 15 feet high. Scattered among the cactus and vine-tangles there is a stiff bush with excessively strong, sharp, hooked spines. This gave considerable difficulty in getting about. A species of *Euphorbia* grows in thickets and in these the Webster's boobies build their nests. Mr. Duhem and I visited one of these colonies and took a series of pictures. Some of the nests had fresh eggs, others young birds. One egg is a full set. The birds of the previous year were abundant on the rookery.

The blue-faced booby was found in considerable numbers but does not colonize. The individual nests were found here and there on the ground and usually contained two eggs each. Many had hatched and a few of the birds were almost half grown. Mr. Tose assisted by Mr. Lot, the chief engineer, took about thirty sets of eggs of each of the species of booby. Doves were very abundant but showed no sign of nesting. Several of the birds were captured alive. The wrens were rather scarce and the only nest found had four half-grown young. An open nest which was rather common in the bushes looked very much like that of a towhee or large sparrow. We know of no bird from Clarion which could possibly have made such a nest. The builders certainly must have migrated at the time.

One of the most interesting birds studied was the little ground or burrowing owl. They were found in considerable numbers beneath the tangles of vines and cactus. Usually one or two or an entire family would be standing nonchalantly about the entrance to the burrow. The smallest ones were well able to fly, so the nesting season was evidently long since past. Several of the burrows were excavated for eggs but without success, much to our regret.

The presence of this owl on this far distant island was the cause of considerable speculation. I believe it has been called the same species that lives in Lower California where the food normally is small mammals, in part at least. But here we saw no evidence that any thing but insects had been eaten.

Ravens were common everywhere and their nests were found in the cliffs. Messrs. Mason, Keifer, and Musser the

next day succeeded in collecting one with one fresh egg. The food of the birds was found to be land crabs and the fruit of the cactus. Possibly other articles may be eaten at times.

Land crabs were not much in evidence, presumably because this was the dry season. But remains of carapaces and the burrows they had made were common.

Mr. Keifer added a large number of insects to the collection. Wasps, bumblebees, and grasshoppers were common. Some hawk moths and three species of butterflies were taken.

Mr. Jordan and the chief machinist's mate collected fishes along the tide pools and secured about 30 species we had not previously taken. Many of these were close relatives of the gaily-colored coral reef fishes of the south seas and Hawaii.

April 28—Clarion Island is surrounded by a coral reef but this is not so well developed as those of the south seas. On the south side, at Sulphur Bay, there is a large area over which the heads of the coral project at low tide and in the caverns and interstices of this reef we found collecting excellent. Much of the coral has been pounded to pieces by the waves and at this point it is piled in great ridges back from the beach, white as snow in the sun. Marine shells of many kinds and sea urchins and starfishes have been washed up with the coral.

When the ship was anchored in Sulphur Bay, Captain Nelson was able to determine that the bottom was sand. We therefore could not lose this opportunity to dredge the bottom and April 28 was largely given to this work by several of us. It is exceedingly difficult to use any kind of dragging apparatus on bottom which is composed of large rocks or growing coral. Our method of procedure here was to take the dredge and a coil of rope in the motor boat out seaward, one end of the line having been made fast on the ship. When the line was all out the dredge was dropped. After a sufficient time had elapsed for it to reach bottom it was slowly hauled in with one of the winches on the ship. In this way it was possible to proceed slowly and not unduly strain the line or dredge bag.

We used a dredge about two feet wide made of heavy band iron, sharpened on the edges so that it made no difference which side fell on the bottom. In addition, our little beam

trawl, about six feet wide, was used with excellent results. In the construction of this we departed radically from usual procedure and built the frame of galvanized pipe entirely. This made an exceedingly strong frame, yet it was demountable and took up very little space.

These pieces of apparatus brought up enormous quantities of broken coral, coral sand, and seaweeds. The latter belongs chiefly to one species which grows as long slender stalks, round in cross section and bright green in color. The sailors called it "spaghetti." All of this material contained large numbers of shells, starfishes, sea urchins, crustaceans, and some fishes and octopuses. It was exceedingly interesting work for all hands because no one ever knew what strangers the next dredge haul would produce. With this equipment we could not work where the water was more than about 200 feet deep but we looked forward to much of such work about the Revillagigedos. In this we were disappointed because at no other place about the group did we find a suitable bottom for the use of the apparatus.

On shore the various workers continued to add largely to the collection. Messrs. Tose, Wright and Gallegos seemed to have the most difficult task of all in trying to keep their collections of birds prepared up to date. In a short time in the field each day more specimens could be collected than could be prepared, even by working far into the night.

In a full day of collecting in various parts of the island, Mr. Mason secured only two species of plants he had not previously found. He did collect about two pounds of beans of the species which grows so prolifically in the semi-desert climate. These have a hard shell, are about half an inch long and would be well worth cultivating if found palatable.

Messrs. Keifer, Tose, Gallegos and Musser prepared to stay on shore overnight. It was especially desired that some of the night-flying moths be secured if possible and Mr. Keifer took all the necessary apparatus with him for an attempt.

April 29—Mr. Jordan and I continued the collection of fishes and succeeded in getting about 12 species we had not previously taken. Some of the shells looked like species found on the Galapagos Islands while others unquestionably are

found along the shores of Lower California. The collectors who stayed ashore overnight got few specimens and the day was spent largely in taking duplicates of rarer forms previously taken.

April 30—Messrs. Mason, Keifer, and Musser went to the top of the island and to the cliffs of the north shore. One species of plant was found which had not been taken before, a shrub about 15 feet high and the nearest approach to a tree thus far found. Mr. Keifer found numerous insects he had not taken before and remained for the night in the highlands, hoping for better success than he had during his previous stay on shore.

Everyone who goes on shore to work gets his clothes stained black with the juice of a species of *Euphorbia*. This plant grows in dense thickets about three feet high. The branches are brittle and it is easier to force a way through than to fight the intolerable cactus which covers so much of the surface.

Messrs. Slevin, Tose and Gallegos went to the top of the island to the west of the center and in some large grass-covered areas on top they found numerous tunnels of Townsend's shearwater. One egg, two young, and five adult birds were secured after excavating a great many burrows. The soil there is soft and reddish-brown, easy to dig but very dry. We knew beforehand that this bird nested on Clarion Island but the exact locality could not be learned. We had almost despaired of finding it until today.

Mr. Duhem, with the aid of two young men from the ship, continued to add to his series of motion pictures and today worked to the westward from the landing and along the coral beach. Several green sea turtles were found and photographed. In one place on a solid, elevated part of the beach, Captain Nelson found some pot-holes about three feet deep and three to five feet wide. The sides were straight and very jagged. Many of the holes contained turtle bones and he was at a loss to account for the occurrence until in one of them he found an unfortunate turtle alive. Its flippers and the edge of its carapace were greatly lacerated from constant and long continued attempts to climb out of the natural trap. It was in an

advanced stage of starvation when found, but showed no definite sign of appreciation when liberated.

I went to the top of the easternmost peak on the island, but found no shearwaters. Two golden plovers, two western gulls and four curlews were noted, but I saw no signs of mammals or land birds other than those already mentioned.

Above high tide and at the east end of the westernmost sand beach there was a pool of foul water, six feet wide and 20 feet long. It is in what is evidently a drain from a level flat area between the beach and the base of the mountain, an area indicated as a lagoon or lake on some maps. During the rainy season freshwater does stand on the flat, a fact demonstrated by the presence of a space devoid of vegetation and covered with mud cracks. Marsh grass, rank in growth, surrounds the area.

I tasted the water and found it heavily charged with mineral but possibly potable in an emergency. The doves were flocking to the place in large numbers and seemed to enjoy the water as well as if it had been perfectly sweet. I have no doubt fairly good drinking water could be had in a shallow pit or well sunk almost any place on the flat, preferably back as close to the hills as possible. This pool contained a considerable number of water beetles which Mr. Keifer stated offered positive proof that the water was essentially fresh and that its impurities were collected by leaching through the soil.

When I returned to the beach from the hot, dry, cactus-chopping trip to the top of the mountain I found a beautiful little tide pool about five feet deep, five feet wide and eight feet long. The temptation to take a bath was irresistible and I was enjoying myself immensely when I noticed beside me in the lava walls, the wicked, snake-like head of a large moray. The fish was moving about in various directions as if in search of food. Tide pools thereafter did not possess the same attraction for bathing.

May 1—Messrs. Tose, Gallegos, Wright and three men from the ship went to the top of the island again today to dig further in the burrows of Townsend's shearwaters and after much labor they returned with a few more birds and eggs. Many of the young birds are half-grown; it is therefore likely the

eggs which still remain are infertile. They were packed in such a way that they could be taken back to San Francisco for final preparation.

During the night on shore Mr. Keifer secured an excellent lot of insects, chiefly of species which could not be taken otherwise, such as night flying moths. Just before he joined the last shore-boat at 3:30 p. m. he turned over a brush pile he had made as a natural retreat or trap for beetles and there was a fine species he had not found before. In dry hot climates this seems to be an excellent way to capture beetles, a method, I believe, suggested by the esteemed coleopterist, Dr. E. C. Van Dyke.

Before noon, Captain Nelson, Mr. Duhem, Mr. Jordan, Mr. Musser and I went to the west end of the island to collect fishes and get photographs of the strange Monument Rocks. The water about these rocks was exceedingly rough and on account of the shallow bottom being blocks of lava, we thought some new fishes might be obtained, but we were disappointed. In the afternoon Chief Engineer Lot did catch on a hook a labroid fish we had not previously found. At the time we were working over some shallow sand bottom between beds of coral in Sulphur Bay, searching for flounders. Some of the men from the ship had reported seeing the latter at that point but we did not find them. An examination of the sand of the bottom showed that it contained enormous numbers of Foraminifera and minute Mollusca. A good supply of it was saved.

Messrs. Mason and Solis collected cacti and seaweeds close to shore and Mr. Contreras did the same with shells. Everybody came aboard ship at 3:30 p. m. and the ship headed toward Socorro Island soon after. As we drifted out to deep water a final cast of the trawl was made but we had little success because we could not control the movements of the ship well enough.

All members of the party believed that they did a very creditable piece of work on Clarion Island. No doubt a longer stay would have resulted in the acquisition of a few more species but this would be true irrespective of the length of our stay.

Quite obviously we arrived at the wrong season for the best work among the plants, insects and birds; but since we had no

data upon which to compute the periods of rain, we had to take this chance. One of the objects of this expedition was to supply this deficiency, in so far as possible from a brief visit.

Bright sunshine which greeted us throughout our stay had evidently prevailed for a long time. Most of the vegetation looked to be autumnal; leaves had fallen, seeds were ripe, and apparently the perennials were the only ones in bloom to any great extent.

It is my belief that the rainy season begins in September or October, and ends in January. The land birds were not nesting and the young ground owls were fully grown and flying. It would seem that fresh eggs could not be had later than February. The same is true of the wrens.

The suggestion is therefore made that future expeditions try to arrange to reach Clarion about January.

May 2—At 8 a.m. we were at Roca Partida, a strange pinnacle about 60 miles west of Socorro Island. This rock is about 100 yards long; the two ends, about 100 feet high, are connected by a low isthmus not over 20 feet above the sea. At

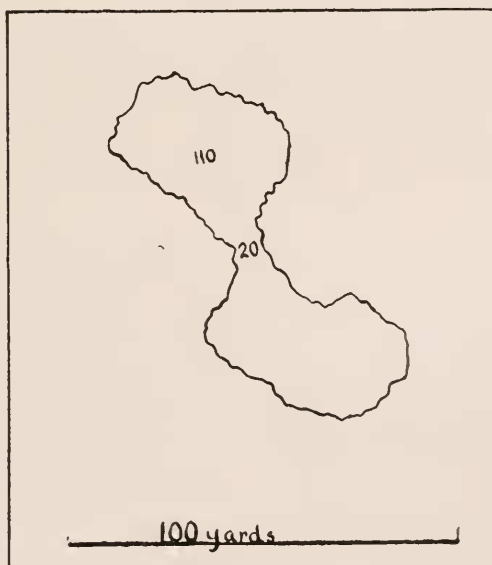


Fig. 4. Roca Partida.

a distance the object looks like a schooner under sail. We stopped and lowered a boat to make collections of fishes and birds. Of the latter we found Brewster's boobies, noddy terns, sooty terns and man-o-war birds. The sooty terns were nesting as was evidenced by a young bird picked up in the water beside the rock. Possibly the noddies also nest but it is not likely that the others do; there is no vegetation on the rock for the construction of nests.

Six shots of dynamite beside the rock wall produced seven species of fishes, and a shark was caught on a hook from the deck of the ship. Giant rays swam lazily about the ship but defied all of our efforts with the harpoon.

The walls of the rock extend straight down into the water to a great depth; 50 feet away, Captain Nelson found the depth to be 210 feet. Coraline algæ (red and pink in color) grows on the walls in the wash of the sea and some crabs were seen crawling about like flies above the water line. This species appeared to be the same that had been found on Clarion Island in similar situations. Likewise, the fishes were species which had been taken on the western island.

This rock did not appear to be composed of volcanic material but from the boat close by it seemed to be composed of a granitic rock, very resistant to weathering. Rocks of this class are usually associated with continental areas and its presence here, far out in the Pacific, led to some interesting speculation as to the possible former existence of a Pacific Continent.⁶

The high central peak of Socorro was in sight soon after we left Roca Partida and as we coasted along the south side of the island the topography was eagerly scanned with the glasses. At 4 p. m. the anchor was dropped in Braithwaite Bay, an indentation of the coast line at the southeast end of the island which afforded quiet water with the wind and sea coming from the northwest as they were then. Sheep were seen on shore near the beach and as the larder was getting low in fresh meat, it was thought best to send a rifle party ashore first and secure a supply before the animals were frightened

⁶ Some of the data bearing on this subject have recently been published by the author in "Science," n. s. Vol. 62, No. 1613, Nov. 27, 1925, pp. 491-492.

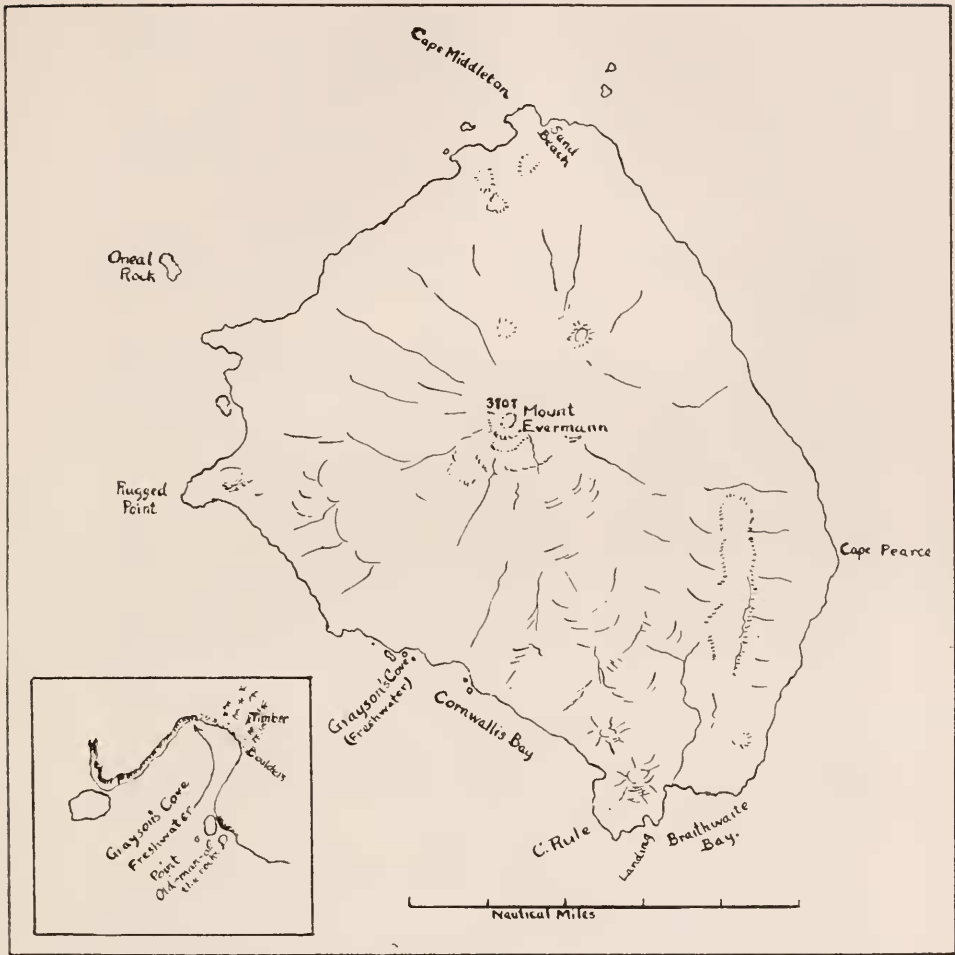


Fig. 5. Socorro Island

away by the collectors. Eight were taken before dark, six being the result of Mr. Wright's skill with the rifle.

During the evening several species of fishes were taken about the ship, and preparations were made for intensive collecting at the break of dawn.

May 3—Messrs. Slevin, Wright, Keifer, Mason, Solis, Contreras and Musser worked out from the regular landing at Braithwaite Bay all day but in the main had rather poor suc-

cess. This southeast end of the island is quite barren and the surface is mostly excessively rough with a confusion of lava blocks. Mr. Mason took only 15 species of plants. Mr. Slevin got 25 specimens of a beautiful lizard, the only reptile known from Socorro; in 1905 he and another man took 80 of them in one day. Mr. Keifer went inland farther than any one else but found few insects. In a lava cave he found some water dripping slowly from the roof. Mr. Slevin also found a slight seepage of water near Binner's Cove where birds were drinking.

Mr. Wright took about 40 birds among which were warblers, towhees, mocking-birds, night herons, and three elf owls. Two of the latter were not quite full grown. This is said to be the smallest owl in existence and we were particularly pleased with the catch because the records indicated that only four specimens were known in the museums of the world. Mr. Keifer saw a flock of parrots where he went but none was captured. Likewise no doves were taken but with these exceptions all land birds previously known from Socorro were captured the first day. One of the men from the ship shot a red-tailed hawk. This is a fair commentary on the thoroughness and industry of the various collectors.

Messrs. Jordan and Duhem collected a very considerable number of fishes along the shores. They accompanied Captain Nelson and me around the south side of the island where we went in search of Grayson's Spring.

In 1869 Colonel A. S. Grayson sailed from Mazatlan for the Revillagigedo Islands on a private expedition for the study of birds and his vessel was wrecked on the south side of Socorro Island. At the landing place a spring of freshwater was found. Undoubtedly after his return to Mexico, news of this discovery spread but from that day to this the spring was never relocated. Around Mazatlan and San Blas it had come to be regarded as a sort of myth handed down from earlier days.

It so happened that Grayson's notes on his experiences were forwarded to Dr. Geo. N. Lawrence with a collection of birds and in describing the latter in the Proceedings of the Boston Society of Natural History he quoted the notes in full.⁷

⁷ See Proc. Boston Soc. Nat. Hist., Vol. 14, 1871, pp. 288-290.

Through the knowledge of ornithological literature possessed by Miss Mary E. McLellan of the Academy we were acquainted with the account and had no trouble in going directly to the spot as Grayson had described it. His notes are so lucid that they are well worth quoting in full since the original publication is very rare in western libraries.

"For four days, the wind headed us off from the Island most provokingly, or rather from a landing place. We first endeavored to go around the north side, but found it too difficult on account of head winds; we then tried the south and, after beating against the wind and a strong current, finally reached the cove marked on the chart as Cornwallis Bay. In this cove, I had been two years previously.

"Although it is a very unsafe anchorage, yet it is the only place we could find fit to come to anchor, in which we might lay with any show of safety. The shores of this cove are rough and rocky, upon which the sea breaks in the calmest weather. There is no beach to land upon, instead of which, at its head, are heaped up round water-worn stones, and its sides are bold and precipitous. We did not see when sailing nearly all around this island, any beaches or a better place to land than this little cove, which opens broadly to the southwest.

"On the 19th of May, seventeen days from Mazatlan, we ran into this little bay with a fair breeze, and delighted with the green trees at the head of the cove and the song of birds among them. But the captain appeared to feel a great deal of uneasiness at the general appearance of things. He let go the anchors, as he thought, a little too near the shore, and the breakers so near and all around, filled him with fear; and just when we felt that all was safe and our voyage at an end for the present, he ordered the anchor to be hauled up and at the same time the main sail hoisted, with the intention of beating out against a head wind; his excuse was that the anchor would not hold. But this movement proved fatal to our craft. Before headway could be made, she was driven in by the wind and swells among the breakers near the shore; both anchors were again 'let go,' but it was too late, her doom was sealed. We made every effort to haul her out by kedging with the small anchor, this being taken ahead with great difficulty in the little skiff and dropped—we would then pull upon the chain; but futile was the effort. Her centre-board had already struck and broken off and her keel was thumping on the rocks as she surged heavily at her chains, which threatened every moment to part.

"We now turned our attention to saving the water and provisions; the former giving me the most anxiety. As for the latter I had no fears, as fish of excellent quality swarm around the shores and are easily taken with hook and line. We still had hopes of saving the sloop when the sea became a little smoother, as she was not yet much damaged. We, however, made preparation for landing everything we could. A rope was fastened to a point of rocks about twenty-five yards distant, to facilitate our landing, and the skiff was pulled back and forth just when the sea

would give us an opportunity of jumping ashore; much caution had to be used in this exploit, the sea breaking furiously at times upon this rock.

"Mr. Anderson being seasick, from which malady he suffered the entire voyage, was first put on shore, afterwards my son and the boy Cristobal were landed, in order to receive the different articles as they were thrown to them from the skiff. The water casks were all hoisted on deck in order that, should the sloop break up, they would float ashore; the provisions, guns, ammunition, and other articles most needed for the expedition were all soon safely landed.

"I remained on board till all these things were on shore. Cristobal, who had gone a few steps up the cove, suddenly cried out to me with demonstrations of the most lively joy, 'aqua, aqua-dulce,' pointing at the same time to an ugly pile of rocks upon which he was standing.

"There indeed we found a small spring of warm water gushing out of a seam in the solid rock that forms a precipice on the western side of the cove; it was partly concealed by a pile of rocks and boulders, which is often covered by the tide, and the spring so low down would naturally be taken for tide water running back into the sea.

"The uncertainty of the length of time we would have to remain before being rescued from our exile, for it is well known that vessels seldom pass near this island, rendered this discovery of the highest importance. The contemplation of the hardships, toil and intense suffering in search for water in a locality where it seemed extremely doubtful of success, filled my mind with the greatest anxiety, but it was now dispelled by this unexpected discovery, and I felt pretty certain that the preservation of our lives depended upon it. This I became more and more convinced of, as we made frequent and laborious excursions without being able to find it elsewhere."

The spring was found exactly as he had described it and birds in large numbers were still going there to drink. It is believed that enough water flows out of the lava wall to supply at least 100 men in emergency. This is very important because, so far as we were able to determine, there is no other place on the island where drinking water may be had in the dry season.

Since we resolved to return to the spring on a later date and mark it we remained on shore there only a few minutes. We did find some weather worn planks, the last remnants of Grayson's boat, and back under the trees were some rusted iron bands, apparently parts of the bird cages he was obliged to abandon.

May 4—All hands returned to Grayson's Cove and the Captain chiselled a large "W" on the rock wall above the spring; the letter was filled with white cement and the following inscription was made: ORTOLAN—4 May 1925—Grayson Cove—AGUA DULCE.

The location, at the west end of Cornwallis Bay, was marked on the chart and after our return the Hydrographic Office of the Navy was notified so that future editions can contain this important information.

Grayson's camping place was found to be a little paradise under the dense shade of a very peculiar tree. The fruit of this tree is about the size of a walnut and contains numerous seeds in a hard tough shell. The seeds taste much like a walnut. The sap is milky and the leaves are bright green and polished. A great many birds, including parrots and red-tailed hawks, were found in the grove and the collectors made the best of their opportunity. Under the bark of some of the dead trees some fine beetles were collected and several species of land shells, all minute, were found under the dead leaves on the ground. Lizards were very scarce and apparently in hiding. None of the birds showed any evidence of nesting. Two sea cliffs were found where Brewster's boobies were roosting but they do not appear to nest on the island. Petrels were common at sea and noddy terns seemed to be going back and forth to Oneal Rock in large numbers.

May 5—Messrs. Duhem, Jordan and I collected fishes all day in the vicinity of Braithwaite Bay and secured several species we had not previously taken. We tried to use a seine but found this impracticable on account of rocky bottom everywhere. There certainly is an opportunity for the development of some kind of fish collecting apparatus for use in just such situations and although we had no time to experiment in the construction of such here, we were able to suggest some features it should contain. Thus it should be a net with small meshes and capable of being operated from a small motor boat over excessively rough bottom. Probably no apparatus can be used directly on such ground, but it should approach it as nearly as possible because the most desired fishes live among the interstices of the rocks. Probably a net to be towed could

be kept down and spread by the use of metal plates or vanes called "kites."

Collecting marine Mollusca was found to be exceptionally disappointing about the shores of Socorro. No sand beaches and no sand bottom was found; the rise and fall of the tide is slight and all shores are exposed. Therefore the only fauna available is that known as "littoral."

Messrs. Tose, Gallegos, and Wright remained on board ship all day preparing specimens of birds.

Messrs. Mason and Keifer went inland and eventually penetrated the fog of the higher ground to a distance estimated to be within 500 feet of the top of the central mountain.

It should be explained that Socorro Island is roughly circular in outline and a little more than eight miles in diameter. The surface rises to a central peak, stated by the U. S. Hydrographic Office to be 3707 feet high. This mountain appeared to be without a name, but we needed one for the proper designation of positions where specimens were collected. After some consideration it was thought that the logical designation for this important landmark is "Mt. Evermann" after Dr. Barton Warren Evermann, Director of the Museum and the Steinhart Aquarium of the California Academy of Sciences, to whom credit is due for the organization of the expedition.

Knowing in advance, of difficulties of ascending the mountain, chiefly on account of the brush of the lowlands, it was thought desirable for Messrs. Mason and Keifer, two of our best travelers, to prospect for a feasible route to the summit.

After crossing an area very difficult to traverse on account of brush and lava they entered a heavily timbered cañon, which was a regular botanists' paradise. Many new plants were found, among which were a wild cherry and a fruit afterwards determined to be a new species of "Bumelia." This was a dark purple fruit about three-fourths of an inch long and with a delicious flavor. Birds were eating it in large quantities. Mr. Mason ventured to follow and no ill effects resulted.

In the cañon were many strange trees, flowers, epiphytic plants and orchids. Birds were excessively abundant and droves of sheep were met with here and there all the way.

May 6—This day was set for a number of us to begin the ascent of the central mountain of the island. We had the reports of Messrs. Mason and Keifer to indicate the best probable approach from the east side.

So far as Mr. Slevin and I had been able to determine the only previous time the mountain had been climbed was in 1903 when Messrs. E. W. Gifford and Sterling Bunnell went up and back in two days. They were members of the Academy's expedition of that year. Mr. Gifford had kept a diary of the journey and was kind enough to let us make notes therefrom before our departure from San Francisco. They likewise had ascended from the east (their camp being at Binner's Cove) and excessive hardships were endured. These were chiefly caused by the cold fog at night and the almost impenetrable brush in many parts. They had discovered some volcanic vents emitting great quantities of steam near the top, and on top they buried a bottle which contained their names and the date of their visit.

Therefore, knowing something of the difficulties to be encountered, we knew a little of the best methods of providing for ourselves for the gruelling trip. The actual distance and elevation to be traversed were not great. The center of the mountain as indicated on the Hydrographic Office chart was placed only about five miles from Braithwaite Bay, our anchorage, and the elevation was given as 3707 feet. But we knew from experience that the heat inland was excessive at this season and added to the other difficulties. Accordingly we cut our rations to the almost irreducible minimum and loaded ourselves with all the water we could carry in addition to the collecting equipment we necessarily must have. Thus equipped Messrs. Slevin, Wright, Jordan, Musser, Smith (pharmacist's mate from the ship) and I set out from the beach at 8:30 a. m. Mr. Duhem with two men from the ship started with us to go up into the foothills with the motion picture camera but it was not expected that this heavy equipment could be taken the entire distance. Nevertheless they went far up into the heavy timber before camping for the night and succeeded in getting some excellent pictures. Their water gave out this first day and on the way down all they had to quench a burning thirst was some canned fruit.

We set out northwest at first, up a small rocky gulch to escape as much as possible the stiff brush of the lowlands. This took us to a series of bare red hills which we followed toward the mountain. Several gullies and ridges were crossed with great difficulty on account of the heavy brush. This was excessively fatiguing and half an hour after we left the beach all of us were drenched with perspiration. Before noon we could have drunk our entire supply of water and not had enough, but we all realized that safety demanded that we keep at least half of our quantity for the morrow.

We had some hope of being able to locate a source of drinking water inland. Such an occurrence would enable us to carry on extensive and valuable explorations which would otherwise be utterly impossible. We thus examined every likely spot with considerable care but were entirely unsuccessful.

On the way across the Red Hills (foothill section) we were impressed by some areas which were entirely barren of vegetation and at first we were at a loss for an explanation. Some parts were covered with dead brush, all flattened on the ground and pointing in the same direction. This indicated the action of water and we decided that the small section of the island had been visited by a great cloudburst at some previous time but probably subsequent to 1903. This supposition was fully proved next day when we found a box cañon leading down from the area to the sea. This was scoured out completely to bed rock while in front of the mouth there was an enormous quantity of boulders piled up. Such downpours as this must be of rare occurrence on Socorro because evidence elsewhere was lacking; in fact, most of the cañons indicated the passage of very insignificant quantities of water at any season.

In the dense brush of the valleys and ridges we had expected to find some sheep trails which would make our labor lighter but, while we found these animals from the shore line to the very top of the mountain, their trails through the brush were too low for us. Considerable speculation was engaged in as to who had planted the sheep and when. We knew Col. Grayson had left pigs on the island in 1864,⁸ and three years later they were still there. We saw no evidence of these animals and it appears that they have completely disappeared.

⁸ Proc. Bost. Soc. Nat. Hist., Vol. 14, 1871, pp. 292-293.

One of the men from the ship found a skull on the lowlands which he thought was from a pig but he failed to bring it in and on a subsequent occasion could not find it. But we had found no trace in any report of a record of the introduction of the sheep. Mr. Gifford found them there in 1903 and so did Mr. Slevin in 1905, but earlier records seemed to be entirely lacking. At Mazatlan, however, the U. S. Consul, Mr. Wm. E. Chapman, had the full details in his files and very kindly had a copy of the following report made for us.

THE REVILLAGIGEDO ISLANDS

*By Edward R. del Rio, Clerk, American Consulate,
Manzanillo, Mexico, April 18, 1923*

The Revillagigedo Islands comprise a group of four islands situated between latitude $18^{\circ} 20'$ and $19^{\circ} 20'$ north and longitude $110^{\circ} 48'$ west. They lie off the coast of the state of Colima about 410 miles. Of this group the principal island is known as "La Isla del Socorro." The others, with the exception of Clarion Island are very small and of less importance. They are, viz: Isla de Benedicto, Roca Partida, and Isla de Clarion. There is little known at the present time of these islands. Information obtained from various sources at this port regarding the largest island of this group, namely "Socorro" is given below:

Socorro Island is situated in Lat. $18^{\circ} 43'$ north, and Long. $110^{\circ} 57'$ west. The island emerges from the ocean to a height of about 3,707 feet, according to information from the Central American West Coast Pilot of 1920, published by the Hydrographic Office of the United States Navy Department. The island is visible in clear weather at a distance of about seventy miles.

HISTORY

Historians, like Sr. Mata Padilla, describe this island as having belonged at one time to the territory known long ago as Nueva Galicia, which formerly was composed of the Mexican States known today as Aguascalientes, Jalisco, Michoacan and Colima. At that time, as now, it has been under the jurisdiction of the State of Colima. The Island of Socorro was discovered some time during the year 1608 by a gallant Spaniard known as Captain Martin Yanez de Armida, who, having been lured by tales of the Toltecas Indians, that a rich treasure of gold was buried on the island, set out to find this treasure in a small boat accompanied by his wife, six mariners and a woman servant. The captain believed this old tradition about the rich treasure buried on the island, until he reached it and began his unsuccessful search. The party abandoned the quest for the treasure and, upon departing from the island, Captain Armida gave it the name of Socorro, in honor of his wife whose name was Socorro.

In the year 1869, under authority of the Mexican Government, an Englishman by the name of John Smith, attempted to exploit these islands, and brought with him and his party from Australia, about twenty-five head of cattle and one hundred head of sheep of the very best breed from Cobu. The cattle very soon died and the few remaining were killed for meat. It is said that the heat on the island killed the cattle but had no effect upon the sheep which thrived and multiplied in great numbers. Mr. Smith died soon after his arrival on the island and his comrades returned to their homes in Australia and Canada. The sheep were left upon the island, and, according to recent reports it is said that there are great numbers of them there. Several expeditions have been made to the island and each time someone has carried away many sheep hides and salted dried goat meat. [The data here unquestionably refer to Guadalupe Island, G. D. H.]

In 1882, the late Governor of the State of Colima made a visit to Socorro Island and upon his return made a very extensive report to the Mexican Government of the richness of the island and the possibilities there for development of the sheep industry. However, to the present time the government has never derived any revenue from these islands. It is interesting to learn that since the first time the sheep were placed upon the island in the year 1869, they have increased in great numbers and are no doubt being smuggled to this day into Mexican and American ports. The pasturage is said to be excellent as the islands are covered with a very good grade of grass. The vegetation and soil is of the same kind found along the west coast of Mexico: very sandy, loamy soil and rich vegetation. The ground everywhere on the island is covered with a thick growth of flat cactus and sage-like brush. [This must refer to Clarion Island.] Much the same growth is found along the coast of Mexico.

For several years it has been stated that the island of Socorro was without water, but, because of the vegetation and animal life reported, the theory is advanced that there is a considerable supply. The pilot of the port of Manzanillo advises the writer that during his visit to the island he located several very good natural freshwater springs of excellent drinking water.

The shores of the islands of the Revillagigedo group abound in fish, turtle, crabs and crawfish and the surrounding vicinity with whales, sharks and porpoises, while the animal life on the islands is composed of birds such as swallows, robins, canaries, parrots, pelicans, sea-gulls, the frigate birds, orioles, and numerous others besides the sheep now on the island.

Of the poisonous reptiles on the island it is said that there are such as the rattlesnake, the "alacran" (scorpion) as are generally found along the coastal sections of the west coast of Mexico.

Doubtless the Mexican Government would welcome the development of these islands by reliable and constructive enterprises, composed of American and English capital.

Unfortunately there are no photographs available of these islands and if one could make a visit there and make a thorough investigation no doubt very interesting data could be obtained and disclosed to the public.

Equally as important as Socorro Island, is Clarion Island of this same group. Its vegetation and animal life is identical with Socorro. This island lies next to Socorro from which it bears 263°, 214 miles.

In spite of the fact that some of the data in the above report is unquestionably mixed, it possesses a very considerable value and enlightened us upon the one point we could not even theorize, the mode of introduction of the sheep.

It will be seen that the historical matter relating to the discovery of the Revillagigedo group differs notably from what appears to be the facts as related by Miss McLellan.⁹

The possibility of making Socorro into a profitable sheep ranch was discussed considerably by our party and it did not seem to those intimately familiar with such work that it could be made to pay. The chief obstacles are the remote distance from ports where wool would be manufactured and the lack of safe landing places on the island. Nevertheless there is a possibility that these difficulties could be overcome and the island is certainly well worthy of investigation by trained sheep men. It was our belief that so far as native fauna and flora is concerned the exploitation of the sheep would do no more damage ultimately than to leave them as they are.

About 11 a. m. we passed out of the zone of brush on the lower slopes of Mt. Evermann and entered the cañons which were densely forested with many kinds of strange trees. The travelling here was much easier and, to all of us, far more interesting. The trees were teeming with bird life, and the "Bumelia" trees afforded great quantities of delicious fruit, which we ate with a relish. It served most to quench our thirst and thus permitted us to conserve the precious supply of water in our canteens.

Occasionally we would lie down to rest under the trees and then the curiosity of the mockingbirds was uncontrollable. They would hop up and peck, jay-like, at our knapsacks or boots, uttering all the time a most non-thrush-like sound. We did not hear them attempt a song at all and would believe they

⁹See *Science*, n. s. Vol. 62, No. 1599, Aug. 21, 1925, p. 172.

have none except for Grayson's brief note saying that he heard them "mock" on rare occasions.

During such rest periods Mr. Slevin succeeded in capturing some living specimens of the beautiful Socorro Island dove (Grayson's dove) which Mr. Gifford desired for his aviary in Oakland, California. The birds were captured with an ordinary fisherman's landing net tied on the end of a stick about six feet long. Altogether 13 of these doves were brought back alive.

Warblers were very abundant in the trees and the beautiful green paroquets kept up a continual screech, amounting in some cañons, almost to a roar. Red-tailed hawks were abundant and very tame; ornithologists will fully understand this when it is stated that one was shot with a .410 ga. gun using No. 12 shot. This fearlessness of the birds is one of the most striking features of far away, uninhabited islands such as this.

Search among the dead leaves by several of us revealed about a dozen species of minute land snails, an assemblage totally different from any I had ever seen elsewhere. Probably most striking was a member of the genus *Strobilops*, a group which reaches its greatest development in central and eastern United States. We did not find on Socorro the beautiful and gaudily colored *Orthalicus undatus* mentioned by Brewer as having been collected by Grayson.¹⁰ The species is abundant on the Tres Marias Islands which Grayson visited on his way to and from Socorro and I cannot help but feel that he made a mistake in labelling his specimens.

Considerable time was given to searching for insects but these were exceedingly scarce under stones and logs where beetles would usually be expected. The ground was very dry, however, and possibly any which may live there had retreated beneath our reach.

One of the trees with white bark like a sycamore was about 40 feet high, one foot in diameter and bore long spikes of cream-white flowers. The fruit was about half an inch in diameter, pale green in color, and was not eaten by the birds. Therefore, we did not try it. The forests in the cañons were so dense that the sunlight rarely penetrated to the ground; hence mosses, lichens, ferns and orchids were abundant on the

¹⁰ Proc. Bost. Soc. Nat. Hist., Vol. 14, 1871, p. 303.

trees and branches. Some of the *Bumelia* fruit trees were fully 50 feet high and although the larger trunks were irregular in growth they were at least five feet in diameter. What appeared to be the canes of a species of blackberry grew to the extreme length of 200 feet but it had neither fruit nor flowers and the identification could not be made with certainty. There was almost no underbrush in these cañons but the ridges and "hog-backs" were practically impassable, we learned through bitter experience during the afternoon. This was rather disconcerting to the experienced travellers who were in the habit of following the elevations in an unknown country in order to obtain a better view of the region being traversed. All of these observations and experiences made a day of hard labor and terrible thirst pass pleasantly.

Early in the evening as the fogs of the mountain top closed in we made our camp at the head of a heavily timbered cañon and a fortunate choice this was indeed. The fog passed over at each side and below us but our camp was dry. This was a great relief because we had no bedding and the night was cold. A fire was kept up most of the night and we were fairly comfortable. The camp was made at an elevation, indicated by our barometer, as 2300 feet, seemingly an insignificant climb but the excessive heat and heavy brush wore us down. The temperature was only 82° to 88° F. during the day but it seemed much warmer than that.

For dinner we each had a dove, roasted over the camp fire, and not long thereafter we were all asleep.

May 7—Next morning at six we were up and getting ready to continue the climb to the top of the mountain. Breakfast was a simple matter. Two men ate a can of beans. Another ate a sandwich and another some cookies. We could not waste much water washing down dry food; hence we did not eat.

After breaking camp we climbed the obsidian ridge ahead of us, 200 feet and into the fog. Then we realized how fortunate we had been to select a dry camp site. The vegetation all about was drenched with mist, yet there was not a drop of water to drink. We followed the ridge upward until we came to an abrupt declivity and we could see no further; therefore we did the only natural thing under the circum-

stances. We stopped for an hour to collect land shells, insects, land crabs and plants, and to await the rising of the fog. All of the time we could hear a steady roar like a railroad train straight to the west of us.

Finally, about 9 a. m., the fog lifted a little and we saw directly ahead a huge jet of steam rising 200 feet in the air. We knew then that we were on the right trail to the top because it issued from a large white area (a mud flow) on a spur on the north side of the mountain. We had headed toward it for a marker the day before.

While waiting for the fog to further dissipate we spent the time investigating the system of fissures, fumaroles and steam vents. These occur in a zone about 500 yards long in a narrow cañon on the northeast flank of the top of the mountain. It is not over 500 feet up from there to the top and the distance is perhaps half a mile. The whitish mud flows out on the side of the gulch and makes a marker which is visible for a long distance.

The fissures are very active. We had no means of measuring the temperature of the steam issuing therefrom but the rush due to the high pressure produced a great roar. Around the vents there was much crystallized sulphur and the odor of hydrogen sulphide was very apparent. The largest vents were about eight inches in diameter. In the upper part of the gulch some of the fumaroles contained water but this was found to be highly acid and entirely undrinkable. These particular vents escaped our notice but were found two days later by Mr. Lot of the *Ortolan*. All of the rocks seen in the vicinity were rather porous lavas and tuffs.

Around the rim of this zone of activity there were found numerous burrows of Townsend's shearwaters, the identification being based upon a portion of a carcass left by a red-tailed hawk at a recent date. Some of the burrows were opened but were empty. The investigation could not be carried very far because we had no digging tools and the soil was very hard and filled with volcanic ejectamenta.

The night before while lying awake listening to the various night sounds of the strange forest, I had heard birds chattering as they passed overhead at irregular intervals and was entirely unable to account for them among the known resi-

dent bird population of the island. The discovery of the burrows confirmed the suspicion that shearwaters actually nest upon Socorro.

From the steam vents we had a steady climb up a steep ridge 500 feet to the top, or what we thought was the top, still enshrouded in fog. After a short time Mr. Slevin saw the shore line and identified Grayson's Cove, from the position of which we were certain we had attained the highest point. Not long afterwards all the fog disappeared and we were treated to a grand panoramic view of the entire island and shore line.

Our barometer showed an elevation of 3373 feet, or 334 feet less than the altitude given on the chart. Search was made for the bottle left by Messrs. Gifford and Bunnell in 1903 but we did not find it. Upon our return we learned that it had been buried beneath the surface, not in a cairn as we had supposed.

We erected a cairn and, following custom, left a bottle in it with the name of the ship, commander, expedition, date and our six names.

Evidently sheep frequent the open, brush-free summit because well beaten trails lead away in every direction. Some charred brush was found nearby in a position which indicated that a fire had passed through. Probably this was a remnant of the fire started by Grayson and which led to his rescue. He spoke of its having spread far and wide over the mountainside before he was out of sight on his homeward journey. Even today the south side of the mountain is remarkably free of brush and is principally grown over with grass and some cactus. For some strange reason the sheep do not seem to range over this area as we saw no sign of trails near Grayson's Cove.

From the top we were able to study the best means of approaching the mountain and found it unquestionably to be from Grayson's Cove. But that route does not pass through any such interesting country as we had traversed on the ascent. Wooded cañons are absent on the south side but are abundant on the north, east and west. Between them brush-covered ridges radiate outward like spokes in a wheel.

Careful search was made from the top in every direction for evidence of water but not a sign could be seen. To the eastward in one cañon there was a dry lake bed which unquestionably does contain a small amount of water during the rainy season. Up to this time we had thought there might be some reason for the supposition of Captain Colnett, that a freshwater lake existed on the island "because of the teal ducks" found flying down to the sea.¹¹ But with the unobstructed view we had we were thoroughly convinced that no permanent lake now exists on the island. It is barely possible that this dry lake bed did hold water throughout the year at the time of Capt. Colnett's visit and has silted up in the meantime. From what we saw of the erosion produced by a cloudburst on the east side of the island it seemed entirely possible for a small lake to be entirely filled with sediment in one rainstorm.

At 11 a.m. we ate a little chocolate, tasted a little water and started down. The trip was made as rapidly as feasible without excessive fatigue but we did not reach the beach until nearly 5 p. m. Choke cherries and Bumelia fruit, picked on the way down helped us to forget our thirst.

Mr. Duhem and his party arrived several hours before we did. Those members of the expedition who did not go inland were profitably engaged in making further collections in the lowlands.

May 8—Messrs. Tose, Mason, Keifer, Solis, Gallegos, Lot and two men from the ship started early for the interior of the island and the top of Mt. Evermann. The climbing party of the previous day remained aboard until after noon when collecting was done near the shore line. Many marine shells and fishes were taken but nothing very striking was found by those working on the land.

May 9—The party returned from the top of Mt. Evermann this afternoon, and, having profited by the mistakes made by those who had gone up before, they managed to endure the hardships somewhat better. Fortunately they took all the water that they could carry and not very much food. The fruit of the Bumelia proved a great help to all of them.

¹¹See McLellan, *Science*, N. S., Vol. 62, No. 1599, August 21, 1920, p. 172.

Messrs. Mason and Lot went to the top of the mountain and added their names to the bottle which had been left. They passed by the cañon which contains the fumaroles, and, from their description, it appears that some changes took place overnight. Some of those which were most active on the day before had completely quieted down. In others there appeared to be a larger quantity of mud and boiling water than we had noted. They brought back samples of some of this mud and an examination of it disclosed nothing of importance beyond fragmentary volcanic debris. The party camped overnight in one of the timbered cañons on the northeast side of the mountain and at 2:23 and 2:25 a.m. everyone in the party was suddenly awakened by severe earthquakes—gentle reminders of the deep internal forces which have built the entire island of Socorro.

We saw no evidence anywhere on the island that there had been any greater volcanic activity than at present, probably for many centuries, but there is no question but that there is a semblance of activity still and it cannot be said that it may not become more severe at any time.

The party brought back many live doves and parrots and the ship began to look like an aviary. Both species live on the fruit of the *Bumelia* and a considerable amount of this was brought along for food. A nest of a red-tailed hawk was found with one young bird about half-grown. This was the third nest of this species so far seen by our party and, from the indications which they afforded, we were apparently about two months too late to secure fresh eggs.

After our experiences on Clarion Island and on San Benedicto later, we were wholly unable to explain the absence of ravens on Socorro. The presence of the sheep, long stretches of rocky shore lines, and much edible fruit, would seem to make this an ideal situation for these birds, but so far as we were able to learn no one has ever seen one there.

Mr. Mason added a great many more plants to his collection from the highlands of the island and believed that he had most of the perennial species. Mr. Keifer carried his gasoline lantern to the night camp on the mountainside and succeeded in securing some very desirable insects, although he was surprised at the scarcity of night-flying forms.

Messrs. Jordan, Duhem, Musser and I collected fishes and other marine organisms all day. Many kinds of fishes were taken which we had not previously secured, the success being largely due to the fact that we used poison in the tide pools. We had brought along some sodium cyanide and chloride of lime for this purpose and found that both chemicals worked well. The cyanide particularly was very efficacious, even in small quantities and in pools which had more or less drainage from the beat of the surf.

A check of the fuel supply of the *Ortolan* showed that it would be necessary for the ship to return to San Diego within a few days for an additional quantity. There was some indecision at first as to whether the scientific party should remain on the Revillagigedos while this was being done, or whether they had better go to the Tres Marias Islands and establish a shore camp there. After due consideration of all the phases of the problem and a review of each collector's acquisitions thus far, the latter course was decided upon. In no branches probably, except herpetology and ornithology, could we be certain that we had specimens of every species on the islands, but this might likewise be said irrespective of the time of our sojourn. It was apparent to everybody that we were too late in the season for the collection of great numbers of the plants and insects which undoubtedly exist on Socorro. Nevertheless, the collectors felt that they had about as good a representation as they would be able to get even if we remained there while the ship made the passage to San Diego and return.

May 10—Messrs. Jordan, Duhem, one man from the ship, and I collected shells and fishes and other marine organisms in the tide pools along shore all day, and a few good things, but not many, were taken. We failed to get two fishes we saw there—one a bright blue species about four inches long, apparently perch-like; the other a little labroid two inches long, purple below and grass-green above. They are the only species we know positively are at Socorro and which we have not collected. At night the submarine light suspended from the deck of the ship has furnished us with a very considerable number of desirable forms.

For a while in the early morning I helped Mr. Keifer collect insects in a cactus patch just to the north of the landing at Braithwaite Bay. Large quantities of a very rank grass grow among the cactus and we felt certain insects must be there, but we had no way of getting them until we hit upon the idea of setting fire to small sections at a time. In this manner a good series of katydids and a large species of grasshopper, which we had not seen before, were taken. At the same time we flushed several night herons and found that they had nested among this thorny *Opuntia*. The young ones were able to fly and this would indicate that the season of fresh eggs would be not later than March. Before we had arrived at Socorro there had been some speculation as to what the food of the night heron might be in such a place as this. The question was settled today and we found that they subsist on crabs and other crustaceans secured along the rocky shore-line.

Mr. Slevin took a few more lizards today and is entirely unable to explain the scarcity of these reptiles at this season. By working energetically for many days he has amassed a very considerable collection, but the single species found is far from as common as he found it in 1905. He made up for the lack of reptiles today, however, in securing two more specimens of the little elf owl.

Another question which no one has been able to satisfactorily answer pertains to the mosquitoes on the island. When parties have camped high up on the mountain-side overnight, not a single one of these insects has been found, but when anyone has been near the shore-line after sunset, he has been pestered unmercifully. This would seem to imply that there are some pools of stagnant water somewhere in the lowlands, but repeated search by many men has failed to disclose them.

May 11—All of the scientific party and the Captain left the ship at 6 a.m. in the motorboat to go around the island. At Braithwaite Bay it seemed calm and an ideal day to make the trip, a day for which we had been waiting ever since we had arrived at Socorro. As we rounded Cape Rule, we found conditions far from pleasant. There was a strong head wind with a heavy sea and so much water came aboard that it was necessary for us to stay close in shore on the south side of the



island. We passed Grayson's Cove and proceeded as far as Cape Henslow; O'Neal Rock was in the distance and we had high hopes of really being able to reach it and investigate the colony of noddy terns which Mr. Slevin had found there in 1905. He had noted then that the nests of boobies on the rock were decorated with dead seahorses. We had made careful search for this strange fish ever since we had left Guadalupe Island but had failed to find a single one. We were very desirous of getting a large collection of them alive to ship back to San Diego in the tanks on board the *Ortolan* and from there they could be trans-shipped to the Steinhart Aquarium in San Francisco.

We were therefore greatly disappointed when, at Cape Henslow, we found we could not make further headway against the wind and sea. Everyone on board was soaking wet with the spray when we reluctantly turned back.

Although the surf was very bad in Grayson's Cove, we did succeed in landing safely on the rock wall on the west side of the cove. Again large collections of birds, insects, plants and shells were made. While Messrs. Jordan and Duhem were landing a fish with a hand-line and dip-net, a shark came up and bit the bamboo handle of the net off clean. The net was saved and a moment later the fish was taken, cut in two.

Late in the day we returned to the ship and all hands made preparations for sea. Quite obviously we must give up hope this time of being able to explore the north and west sides of the island. Throughout our stay the wind persisted from the northwest, thus making a landing on those desirable portions impossible. The island is so rough and the absence of known water makes it impossible to explore very far away from the landing places.

May 12—The ship got under way at 2 a. m. and we reached San Benedicto Island soon after daylight. It was very rough even on the east side of the island where the only anchorage is indicated on the sailing charts. For a while it seemed rather doubtful if we would be able to get on shore at all. Mr. Slevin and I in a rowboat prospected the whole of the east side but not a place was found where a boat could be landed. We did succeed in getting ashore, however, with most of the party,

by casting a grapnel upon a projecting spur. The first man scrambled up the perpendicular lava wall and with a heaving line hauled up and secured a Jacob's ladder. Going ashore and back aboard later in the day was dangerous work, but we managed to do it without an accident. A man overboard there who could not swim would almost certainly have been lost. Consequently it was thought that the two or three in the party in that category had better stay on board. San Benedicto was the most inhospitable place any of us had ever seen. The south end rises in an Ash Heap to an elevation of about 900 feet, the highest point on the island. The ashes are white and the sides of the hill are deeply scored with water channels. Connecting the Ash Heap with the northern part of the island is a low isthmus. Much of the northern part is a high plateau with, in one place, the most perfect crater many of us had seen. After due consideration of this beautiful bowl, it was decided that it should bear a name and it seemed entirely proper that it be called after Dr. Alphonso Herrera, the honorable Director of the National Museum of Mexico.

The shore line of the island has been gradually eroded away by the beating of the waves of the Pacific and on the west side some outlying pinnacle rocks have been left standing.

Messrs. Mason and Solis, with the help of others, took eight species of plants on the island. Three were grasses and one was a morning glory which is found on Clarion Island. One species of grass covers most of the accessible area and grows five to six feet high in places. It is exceedingly rank and dense and very hard to break through. The only other plant present in any abundance is a *Euphorbia*, the brush of which is used exclusively by the man-of-war birds and blue-faced boobies for nests. No cactus was found.

Whenever we went on shore a cloud of grasshoppers advanced in front of us. Some of these were at least three inches long and two species were found, which, with a few small ground beetles, are the only conspicuous insects other than a great many carrion flies about the carcasses of dead birds. Also around the necks of the live birds there were enormous numbers of parasitic flies belonging to the family Hippoboscidae. Some birds had as many as fifty flies each and they seemed to produce considerable discomfort to the host because

they select a position around the bird's neck where they cannot be reached with the bill. A favorite place for them to perch was around the pouches of the male man-of-war birds. When one of these flies would light on a man it would cling with utmost tenacity and could hardly be brushed off.

No lizards or land shells were found on the island.

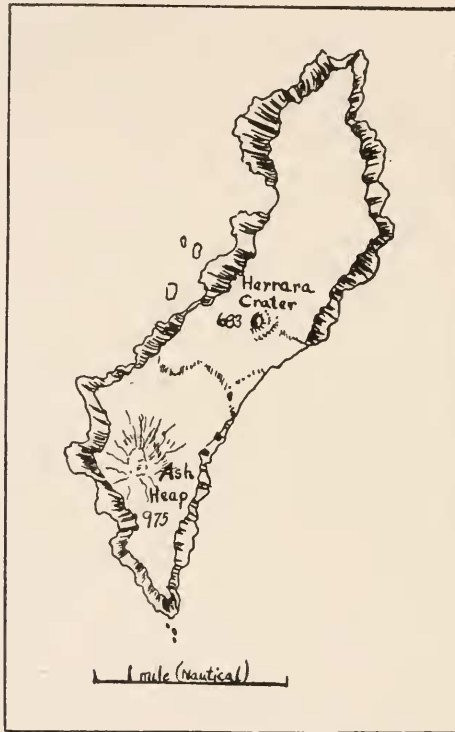


Fig. 6. San Benedicto Island.

On top of the high plateau in the center of the island was a large colony of man-of-war birds and last year's young still remained at the nest although they could fly. Large numbers of dead were strewn over the rookery. Presumably when the new nesting season arrives, the young of the previous year are deserted by the parent birds and if they are not able to take care of themselves by that time they perish on the rookery. Several fresh eggs of the 1925 season were taken. In some

cases the male, in others the female, was on the nest. Sometimes both birds sat side by side crooning each other, the male occasionally filling his enormous pouch with air to its capacity. The nest was placed on the ground or on rocks, and consisted of a sort of platform, flat on top, occasionally being built to a height of two feet. At a distance the "whoo-hoo-hoo" of the males does not greatly differ from the call of the screech owl in the east. The birds were very tame and allowed us to approach the rookery with almost no disturbance.

The three species of boobies—Webster's, blue-faced, and Brewster's—were nesting in abundance in about the order named. The blue-faced booby was closest to the shore line and the nest was placed in the center of an open circle in the grassy areas. A few stems of grass composed the nest. Two eggs were laid and all that were found appeared to be heavily incubated. Some half-grown young of all three species were found. The Webster's nested chiefly in the grassy areas and built a platform one to two feet high of grass stems. Only one egg was found in a nest and all those seen were heavily incubated. There were numerous birds of this species on the cliffs, but they seemed to be only resting. Brewster's boobies were found along the washes of the isthmus, the nest being much like blue-faced and two eggs being the usual number.

Ravens were present, but not very abundant. I saw six. Rock wrens were likewise not very common, but between us we took thirteen. Red-tailed tropic birds were seen circling along high cliffs and the deep cuts of the Ash Heap. Nests were not found, but probably occurred in the latter place. Wedge-tailed shearwaters completed the avifauna. Thousands of their burrows were found in the Ash Heap on the south end and on the higher parts elsewhere on the island. Mr. Wright succeeded in getting seven birds but they were not nesting. He found a way to call them out of the burrows without the usual amount of excavating which is necessary. This he said he did by imitating as nearly as he could two cats fighting. He said whenever he did this shearwaters all about would come to the entrances of their burrows.

While the ship was anchored beside the island, one of our parrots from Socorro got loose and flew ashore. The man-of-war birds chased the poor creature shamefully, each one trying

to force it down into the water and it barely reached land. We did not recapture it and it was not believed that it would survive very long.

The men on board the ship took 42 large sharks over the side in two hours, some being eight feet long. Other fishes were very scarce.

At 4:45 p. m. all hands were aboard satisfied with the results obtained and the ship got under way for Maria Madre Island.

May 13—When daylight came this morning the ship was gliding through a sea as smooth and calm as glass. We could hardly believe our eyes, because this was the first real calm weather we had experienced since we left San Diego. Unquestionably we had passed out of the region where northwest trade winds prevailed and were entering a new climatic zone which would be occupied by many different kinds of plants and animals than those to which we had become accustomed. We cruised all day through the oily sea, enjoying the sensation of freedom from the wind and roll. An occasional petrel or shear-water glided silently past to relieve the monotony of the situation.

At 10 o'clock of the preceding night when we were 55 miles east of San Benedicto Island a wandering wayfarer, a red phalarope, flew aboard and was captured by Mr. Duhem.

A little after noon the Tres Marias Islands were sighted to the eastward and not long thereafter the Captain found that he was headed straight for the passage between Maria Madre and Maria Magdalena islands. We anchored close in front of the Mexican Federal Penitentiary on the east side of Maria Madre Island and at 6 p. m. Messrs. Gallegos, Solis, Contreras, Nelson and I went ashore to learn what arrangements might be made for making natural history collections on the group while the ship returned to San Diego for fuel.

We were most hospitably received by the acting director, Sr. Gallindo, and the commandante, Sr. Sanchez. They very generously offered us a house which we might occupy as headquarters during our stay, a building very well equipped for our needs. They likewise offered to give us any assistance which we might require, such as guides and saddle horses.

All of this was very much appreciated because we had rather expected before our arrival that it would be necessary for us to camp in tents.

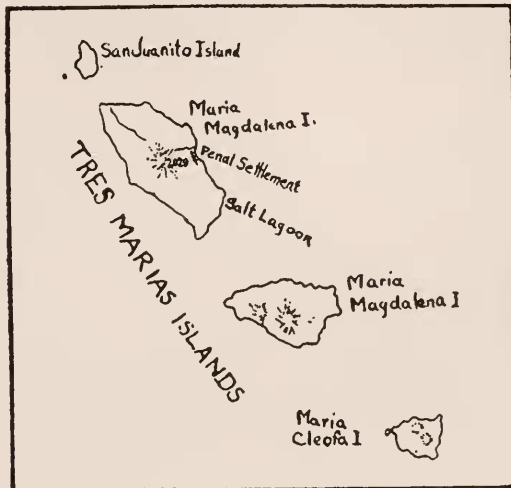


Fig. 7. Tres Marias Islands.

The penal settlement on Maria Madre is quite a large institution. There were 281 prisoners there at the time of our visit and everything about the place looked exceedingly well kept. Buildings were nicely painted, streets were graded and kept constantly watered to settle the dust. It was gratifying to see so well-kept an institution on this far distant isle.

May 14—The twelve of us of the scientific party moved ashore with all of our outfit, prepared for a stay of eight to ten days. The Captain very kindly detailed a cook and mess boy to serve us and with most pleasant surroundings we looked forward to a very successful sojourn. Most of the day was occupied in the moving operations but in the late evening some of us walked south on the beach to Lighthouse Point and we were very deeply impressed with the profusion of life of the tropical forest, even on a semi-arid island. Five species of cacti were seen along this short trail and a beautiful Bougainvillea, orange in color and with a flower $\frac{3}{8}$ of an inch in diameter, was a most delightful sight. Lizards, crabs and

insects swarmed in the intense struggle for existence which seemed to be taking place on all sides.

Parties from the ship enjoyed the day on shore and in the afternoon the crew had a ball game. Sr. Gallegos, a most delightful companion at all times, was here invaluable to us because of his ability to speak English almost as fluently as his native tongue.

May 15—At 9:30 a. m. when most of us were out in the forest making collections in our various groups, we heard three blasts from the whistle of the *Ortolan* announcing her departure for San Diego. We felt that we were in a paradise from a collector's standpoint and looked forward to the days to come with a great deal of pleasure.

Messrs. Slevin and Musser went south from the village as far as the Saltworks Lagoon and collected many lizards during the day. Two snakes were found, one being a racer about seven feet long. Mr. Musser shot a rabbit and also collected a few birds.

Messrs. Tose, Wright and Gallegos collected birds within half a mile of the village for a while during the early afternoon and spent the rest of the day preparing them. Some traps had been put out the night before, but no animals were taken in them. Among the most conspicuous birds were tanagers, flycatchers, orioles, warblers, wrens, cardinals, woodpeckers and caracaras. Three kinds of doves were seen and red-tailed hawks, vultures, parrots, swallows and hummingbirds were not uncommon.

There were so many kinds of plants to be collected and pressed that Messrs. Mason and Solis were not able to wander more than a half a mile from the village. It was quite apparent to all of us that our visit was made in the midst of the dry season. We were told that no rain had fallen for several weeks and the forest had the appearance of autumn in the eastern United States. Most of the trees had shed their leaves and there were but few annual plants in bloom. Careful observation, however, enabled the collectors to find flowers of most of the perennial plants which they encountered.

On account of the dryness of the season insects were probably not as abundant as they would have been at a later date.

Nevertheless, Mr. Keifer succeeded in taking a large series and the acquaintance which he made with the conditions in the forest undoubtedly enabled him to make the best of his opportunities on other days.

Mr. Jordan and I visited some rock exposures in the cliffs, one mile southwest of the village. Numerous species of fossil mollusks were collected and large numbers of Foraminifera were taken in bulk. Many strata of the formation are composed of Foraminifera to the extent of at least 95 per cent. We had no difficulty in the field in placing these rocks in the Pliocene and the equivalent of exposures on Cedros Island and at San Diego.

The center of the mountain mass which forms Maria Madre Island was found to consist of granite chiefly, with a rim of diorite around the edges. This whole mass was land during part of the Pliocene because many boulders of granite are in the sediments of that age. The main cañons have cut into this granite about 300 feet or more. Near the top of the island the Pliocene sediments are only about 50 feet thick, but they increase to about 300 feet toward the shore. The prevailing dips seem to be away from the center of the island. During a portion of Pliocene time large coral reefs existed around this old land mass and large blocks of the fossiliferous material, firmly cemented, have fallen down from the exposures and have rolled indiscriminately far out into the forest.

North of the town a large wash comes into the sea from the westward and in the bed of this we found float pieces of Pliocene conglomerate and large blocks of pure coral several feet square. Also some float pieces of diatomaceous shale were picked up and these indicated very conclusively that some Miocene was exposed to the westward.

May 16—The day began at 4:30 a.m. for the collectors and they all labored industriously in the region about the village of Maria Madre Island. A great many additions were made to the collections which cannot be enumerated or even mentioned here, but we all had come to the realization that in order to make a fair showing of the fauna and flora of this island we would have to work as rapidly as possible. As an illustration I need only cite the experience of Mr. Mason who collected

plants toward the top of the east side of the island. He found a great many epiphytes (such as orchids, cactus, etc.), which he had not seen before. Mr. Mason collected one fresh egg of a night-flying bird which resembles a night hawk in habits and has been called *parauque*. This is the only evidence we have thus far obtained to indicate that any of the resident birds of Maria Madre Island are nesting.

May 17—Sr. Contreras went south in a boat with two pearl divers and made a large collection of marine life. He brought back some very beautiful specimens of living coral and he also took many sea urchins, starfishes, worms, shells and some fishes.

The rest of the party went in a motorboat to the north end of the island at a point past San Juanito Island and ascended a large creek called Arroyo Hondo. The mouth of this is at a point about six miles north of the village. On the beach there are the remains of several buildings and two and one-half miles inland there are three abandoned ranch houses. A guide named Antonio accompanied us and demonstrated many times his intimate knowledge of this densely forested island. Our main objective was a water-hole in Arroyo Hondo.

Along the shore line blue-footed boobies, man-of-war birds, brown pelicans and oystercatchers were very common. Our greatest treat to bird life, however, was far up in the Arroyo toward the running freshwater. In that vicinity one could be reminded of nothing for comparison except a swarm of bees. Doves, robins, orioles, tanagers and warblers were exceedingly abundant. Among them all the red-tailed hawks must have had an easy time capturing their prey. The hawks were so tame that some of them were shot with a collecting pistol loaded with dust shot. Very often in the green foliage, present here because of underground water conditions, we were treated to the sight of the gorgeous trogon. Males of this species are more brilliantly colored than the female and they are held in especial esteem by the Mexican people because they are tri-colored like the national flag—red, white and green.

About three miles from the sea in the Arroyo a diorite dyke crosses the cañon and the water unquestionably backs up behind this because it is at this point that the creek flows on the

surface. Running water is exposed for about 100 feet in the bed of the stream and it is then lost beneath the sand and gravel of the wash. This creek is a very important topographic feature of Maria Madre Island and heads on the north side of the central mountain. Very large quantities of water have been carried at times because granite boulders twelve feet across have been washed far down from the exposure. Under a dead log in the water Mr. Slevin found a specimen of the native Maria Madre Island terrapin, a very rare species in collections.

The exposures of rock in the Arroyo and along the seacoast from the village north were very excellent indeed and they gave us an opportunity to study the geological relationships very satisfactorily. Summarized they are as follows:

The uppermost formation on the north end of the island consists of about 300 feet of Pliocene limestone and sandstone dipping away from the center of the island at angles of approximately 15° . These sediments are very fossiliferous and are underlain by about 1000 feet of diatomaceous Miocene shales. Some of this is very pure diatomite and in it fish remains were found abundantly in two or three places. Miocene shales lie directly on diorite or rhyolite and this in turn rests upon the granitic core of the island.

May 18—The bird collectors needed a day to prepare the specimens collected at Arroyo Hondo so no long trip was attempted. Mr. Jordan and I dredged off shore with the motorboat in the morning, getting a great many things in water 50 to 100 feet deep. Taking advantage of the low tide in the afternoon we made collections of littoral forms along shore.

Messrs. Mason, Solis, and Keifer took saddle horses and went north a few miles into the forest. Among many excellent specimens collected there were two species of cactus of the genus *Mammillaria*.

May 19—At 5:30 a. m. we left the dock at Maria Madre Island in the motorboat and headed across the strait toward Magdalena Island, eight miles away. All of the members of the expedition made the trip and we were accompanied by Sr. Alfredo Sanchez, the Commandante of the Prison, and

Antonio Olmedo, his foreman of the salt works. The latter was brought along by Sr. Sanchez because of his intimate knowledge of Magdalena Island and before our return we had much cause to be thankful for the foresight of Sr. Sanchez.

We left without breakfast, but Mr. Mason, who had had much experience in out-of-doors cooking in France and elsewhere, volunteered to attend to the commissary. Therefore he and the Philippino mess boy, Rosales, were landed first. By the time I had transferred the rest of the party from the boat to shore, breakfast was ready.

Camp site was chosen at the mouth of a small dry creek near the center of the north side of the island, because we thus had access to every part and we had safe anchorage for the motorboat behind the long submerged reef which projects from the north side. This did not give perfect protection from the huge northwest swells of the Pacific but it was the best we could get, according to Antonio, and we learned afterwards he was correct.

The work of the various men in the dense forest was soon under way. Mr. Wright went toward the top of the island up our little creek in hopes of securing a specimen of mainland deer. These animals were "planted" on Maria Magdalena about 1903 and were said by Antonio to have increased somewhat. Mr. Wright was prepared to remain overnight if necessary. He returned to camp next day without having seen any fresh signs of either deer or goats, the latter having been introduced also about 1903. Mr. Jordan and I kept to the creek beds and shore line all day in order to study the exposures of rock formations. Notes on the geology will appear in a later paper, so it is only necessary here to remark that Maria Magdalena Island has had an entirely different history from Maria Madre. Basement rocks are volcanic and are overlain by a great series of cherts, sandstones and mud shales. These we took to be Cretaceous in age but definite paleontologic proof was not found. Miocene appeared to be absent and Pliocene was not positively identified. Pleistocene, however, is exposed near the sea and on the beach at the creek mouth and the flat eastern end of the island is probably an

elevated terrace of this age. The dangerous reefs projecting from the north side of the island are composed of resistant layers of the supposed Cretaceous rocks, the softer shale layers having been eroded away. Many of these resistant layers weather out as huge flagstones. The high western end of the island, the Pacific side, with its enormous sea cliffs, is composed of highly altered cherts with volcanic rocks in many places. No evidence of granite, such as composes the central core of Maria Madre Island was found. Mr. Jordan and I made a large collection of marine shells and corals along the beach and land shells inland.

Messrs. Tose, Gallegos and Antonio went at once to the only water-hole in our part of the island, located about $1\frac{1}{2}$ miles back of our camp and in the next creek bed to the west. There they succeeded in getting a large collection of birds.

Messrs. Mason and Keifer collected in the various cañons leading inland and secured many specimens. At the close of the day's work, all agreed that the fauna and flora of the Maria Madre and Maria Magdalena were almost identical. Evidently transference of individuals from one to the other occurs frequently, a belief that was strengthened by the finding of various drift on the beaches of the latter island which unquestionably came from the former.

Mr. Slevin found no different species of reptiles, nor did any of us find one of the rattlesnakes which the natives maintain live on Maria Magdalena. I did collect for him a large boa which almost caused me to have heart prostration. I was helping Mr. Keifer at the time, late in the evening; we were prying the dead bark from a tree on the bank of one of the dry washes. I suddenly broke through the little pile of rubbish and roots on which I was standing and landed squarely upon the coils of a huge snake. In the dim light I could only see the light diamonds on its back, and my thoughts naturally turned to rattlesnakes. After some teasing, we succeeded in getting the reptile out of its cover and a noose made of a vine over its head. In this manner it was brought to camp and was found to be almost nine feet long. Mr. Keifer went on with his insect collecting.

May 21—While awaiting the return of the scouting parties, some interesting collections were made. Sr. Gallegos, while watching the birds at the water-hole, captured a fine black snake, a racer we had not previously taken. According to Sr. Gallegos, the snake has most interesting habits. Thousands upon thousands of flycatchers, vireos, hummingbirds, cardinals and thrushes come to the water-hole to drink and catch insects. The snake submerges with only its forked tongue above water. This is easily mistaken for an insect and if a bird attempts to capture it, the snake suddenly strikes with deadly effect.

In traveling the beach yesterday, Mr. Wright and I found a sea snake, dead and dried, but otherwise in good condition:

We also collected a set of oystercatcher eggs and noted the following other water birds: great blue heron; yellow-crowned night heron; brown pelican; blue-footed booby. The pelicans roost in the trees near shore, the boobies on outlying rocks.

Late in the evening the collections were taken aboard the motorboat and the party returned to Maria Madre Island.

May 22—Messrs. Slevin, Jordan, Keifer, Duhem and I went in the motorboat to the salt-works four miles south of the village. There we found a very considerable industry in active operation. It is made possible by there being a completely enclosed lagoon separated from the sea by a narrow neck of land. The natural presumption is that sea water seeps through this embankment and, through evaporation, concentrates in the lagoon; and it may explain the presence of the highly concentrated brine. Two facts, however, tend to indicate that the saltwater has a different origin. In the first place, the brine is carried in buckets to a large number of shallow concrete vats where it is allowed to evaporate to complete dryness. The resulting salt is said to be very pure. This procedure could not be followed with sea-water, but a certain amount of "mother liquor" containing calcium and magnesium salts would have to be eliminated. Moreover, in the bottom of the lake and under about one foot of mud, there is an 18-inch layer of calcium sulphate (gypsum) in huge magnificent crystals. The presence of this material certainly indicates a subterranean source for the salt water, it having at one time been

charged with that sulphate. On account of these facts, there was some doubt in my mind as to the sea-water origin of the lagoon brines.

At the time of our visit, the brine was very concentrated. Salt crystals grew rapidly upon any partially submerged object. The water was deep red in color, due to the usual brine inhabiting organisms.

About fifty prisoners are employed in the salt-works. A local lime-kiln is maintained for the burning of Pleistocene, highly fossiliferous rocks to make cement for the vats. The salt was sold to a contractor for a price said to be \$7.00 per ton and he carried it in small vessels to Mazatlan, San Blas and elsewhere.

Investigation of the near vicinity showed flat lying Pleistocene rocks immediately back of the salt-works and, because the entire southern end of Maria Madre is level and not very high, we were led to believe the entire exposed formation of that end to be of that age. The difference between the southerly and easterly dipping Pliocene rocks and the flat plateau was very marked at the line of contact. The rocks were not well consolidated in most part. Corals, mollusks and Foraminifera were so exceedingly abundant that a good grade of lime is produced.

May 23—Messrs. Slevin, Mason and I went into the hills of Maria Madre today, chiefly for the purpose of taking a series of photographs. Many of the exposures secured turned out later to be very good. Numerous pictures of local plants in bloom were very desirable and we also got a series of the iguanas which were so abundant everywhere. Mr. Duhem had discovered in taking his moving pictures of the animals that they would follow him like a dog if shown a cactus fruit. Undoubtedly this fruit forms one of the chief articles of diet and, by offering them some on the end of a stick, we were able to get some good pictures, close up.

Mr. Slevin came across an exceedingly thin, vine-like arboreal snake on this trip, a well known mainland species but one which had not previously been found on the Tres Marias Islands.

The *Ortolan* arrived with a new supply of fuel at 1:30 p. m. and the rest of the day was spent getting equipment and supplies aboard and sorted. In the evening we bade all of our friends on Maria Madre Island goodbye, after having thanked them most heartily for the help they had given us. Our stay had been exceedingly pleasant and no one had other than praise to offer for the orderly, business-like way the institution there was handled and governed.

May 24—After a general conference regarding the work yet to be done by the expedition with the fuel on hand, it was decided that Maria Cleofa Island would better be eliminated from the schedule. The contour of that island is such that, with the northwesterly sea which had been running for weeks, our chances of making a landing without a long wait were very small. Likewise, the waters about the little island of San Juanito contain such dangerous reefs that it seemed unwise to proceed there with a vessel the size of the *Ortolan*. Moreover, our visit to the Tres Marias Group was admittedly for reconnaissance purposes and all agreed that from this standpoint we had been quite successful. A stay of two or three months would be needed to make a thorough exploration of the group.

Therefore, at 2 a. m., the ship got under way for Isabel Island, 40 miles northeast of Maria Madre. We reached our destination at 6 a. m. and the usual activities of the party began at once.

Collecting was good in some groups, very poor in others. Mr. Slevin took over 200 specimens of lizards, three species being represented. There was no great assemblage of species of plants. Two small stunted species of trees cover most of the island, the remainder being overgrown with grasses. The trees have a maximum diameter of about eight inches and a height of not over ten feet.

The place is a paradise for sea birds and some outlying rocks were covered with pelicans and Brewster's and blue-footed boobies. The latter nest underneath the small trees near shore but the young birds had either hatched or were well grown. They roost in large numbers on the cliffs at night and when Captain Nelson blew the whistle prior to our

departure, the ship was deluged with birds. The boobies lost all sense they may have ever had and flew at our lights with utter abandon.

On the north side of the island there is a grassy area covering perhaps 10 acres. Each little hummock was the location of a nest of a sooty tern. The young birds were well grown and had flocked to the shade of the bushes nearby for shelter from the sun. One or two infertile eggs were collected. Noddies nest on the bare rocks of the north shore line and a few eggs of this beautiful tern were collected.

Man-o-war birds nest in considerable numbers in the center of the island on weak platforms built on top of the low trees. Most of the eggs had hatched showing that a much earlier nesting season exists on Isabel Island than on San Benedicto Island. Brown pelicans occupy a small rocky area near the highest part of the island and the young were almost as large as the parents. Red-billed tropic birds were constantly circling about the shore lines and in holes in the cliffs of soft scoriaeous rock of the southwest side numerous nests were found. One speckled, reddish-brown egg is laid in the dark recesses of a cave and is guarded jealously by the parents. They literally had to be pulled from their nests before the eggs could be collected. Mr. Wright and I succeeded thus in taking 14 of these rare specimens in the afternoon. Young, from newly hatched to almost full grown, were found in the various nests examined, indicating a greatly prolonged nesting season. The raucous note, powerful flight, fighting proclivities and long, slender tail feathers certainly make this the most striking sea bird of these parts of the tropical Pacific.

Close to shore and on the northwest side of the island, there is a breeding colony of Heermann's gulls and they may occupy some of the outlying rocks. Young were fully fledged and almost able to fly.

The landing place on Isabel is on the south side and with northwest winds is safe for small boats. We found that the island had been occupied until very recently by shark fishermen. A large number of sharks had been caught and dragged out upon the beach. Evidently the only parts saved were the

livers and a crude try-works for the extraction of oil from these was hardly cold. The stench from the rotting carcasses was almost unbearable about the landing place.

We learned on Maria Madre Island that a concession had been recently granted for prospecting for oil on Isabel Island and I was curious to learn what had been the cause for supposition that petroleum might exist there. We found the island to be wholly volcanic. Lavas and scoria make up the entire land surface. Back of the landing place a few yards, there is a small pool of foul water possibly derived in part from surf driving through the coral rock dam between it and the sea, but certainly in large part derived from subterranean sources. The water is very bitter to the taste and does not contain a very large amount of common salt. Beetles which belong to a family that inhabits alkaline waters were abundant on the bottom and at the west end there is a seepage of water from the bank into the pool. The mud at this seepage was so hot I could not bear my hand in it.

A crater a fourth of a mile across occupies the southeast corner of the island and is filled to about sea level with alkaline water similar to that of the pool just described. A lava rim separates the lake from the sea on all sides, the lowest point being about 200 yards from the landing place and about 30 feet high.

Apparently the water of these two pools is made very foul from the birds, at least in part, and it is entirely conceivable that a film of oil may spread over the surface at times from this cause. Mr. Wright and I found some black tar-like seepages from the excrement of the birds under some of the shelves of the sea cliff of the southwest corner. Only by mistaking some such fact as this could anyone be induced to suspect the presence of petroleum, a deposit of which in such a situation is of course practically impossible.

While working over these southwest cliffs, Mr. Wright and I found a small seepage of apparently drinkable water coming from a seam in the scoria-rock. If an excavation were made there, it is possible that enough might be collected to be used in emergency. The place is on a shelf about 25 feet below the

top of the cliff on the southwest corner of the island. The shelf is easily reached from the north and can be followed along for a considerable distance. In the caves extending back from this shelf we found the colony of nesting tropic birds.

The day was considered very successful by all of the party and the work having been completed, the ship was headed toward Mazatlan at the proper time to reach that port after daybreak next day.

May 25-27—We were very hospitably received in Mazatlan by the local officials and our stay there was very pleasant indeed. Sr. Gallegos had been stationed at the port once for three years and acted as our guide. The Academy party was particularly anxious to become acquainted with local conditions in order that proper preparations could be made in due time for collecting work in that vicinity. They were aided in this by the guidance and counsel of Mr. Wm. E. Chapman, the American Consul. We attended an exposition which was being held there jointly by the States Sinaloa, Sonora and Nayarit and all of us were greatly surprised at the wide variety and fine quality of articles manufactured. The exhibition of natural products was very instructive to us. We went by automobile from Mazatlan to Roble, 30 miles away, where the Haas people have a plantation, the chief product being sugar.

Since Mazatlan is on the main line of the Southern Pacific Railroad of Mexico, and is a regular port of call for many ships, space will not be taken to record data about the ancient and picturesque city. Tourist guide books should be consulted for such information; our duties were outside of the beaten paths. Therefore, on the evening of May 27, we were again under way, anxious to continue with work we had outlined.

May 28—We reached Cape San Lucas at 2 p. m. and went ashore at once to collect as much as possible at this classical locality during our brief stay. The place is famous in biological literature through the activities of John Xantus de Vesey, an industrious naturalist who was stationed there about the middle of the nineteenth century.



At the cape we met one of Prof. John N. Cobb's students from the fisheries school of the University of Washington, Mr. T. Suzuki, a Japanese. He knew Dr. Evermann and had collected a live hawk-bill turtle for him. It had been kept in a wicker trap for several days and when we went to get it, it was dead. This was a misfortune because, being of small size, it would have made a very desirable specimen for the Steinhart Aquarium. The turtle was not lost, however, because Mr. Slevin made a museum specimen of it.

The cape region is evidently becoming of considerable importance from a fisheries standpoint. Besides a Japanese refrigerator steamer which was being loaded with frozen fish, a sailing ship fully equipped as a refrigerator was anchored close in shore and was in full operation.

The extreme tip of the peninsula of Lower California is a narrow granitic promontory. Behind this is the harbor protected from northwest winds only. Evidently a strong current eddies around the cape because the *Ortolan* had to go within 200 yards of the beach before finding soundings to indicate suitable anchorage.

The next stop on our schedule was Magdalena Bay on the west side of the peninsula and in order that our arrival there might be timed properly, it was necessary to leave Cape San Lucas at 4 p. m.

May 29—At 3:30 this morning as we were cruising along peacefully about 20 miles south of the entrance to Magdalena Bay and several miles off shore, the ship's engine suddenly began to race and the vessel was subjected to the most violent vibration therefrom. The officers knew at once that the cause was the loss of a blade of the propeller, a prediction which was verified after we anchored in the bay. This accident, we foresaw, would handicap us considerably, but it was thought to be safe to proceed to San Francisco under a speed of not more than six miles per hour. The remaining stops which we wished to make, except Guadalupe Island, lay practically on our course, so it was decided that we might make them providing we did not remain so long as to endanger our fuel

supply. The plan to revisit Guadalupe for the census of elephant seals had to be abandoned, much to our regret.

We could not think of a possible cause of the accident to the propeller until after we had inquired into the activities of a whaler who was operating from a floating factory in Magdalena Bay. The operations had consisted of killing the whales at sea, towing them in to the "plant" where the blubber was stripped off for the manufacture of oil, and then towing the carcasses out to sea to be cast adrift. Apparently our propeller had struck one of these carcasses. At the time of the accident, nothing could be found floating on the sea and there are no known submerged rocks in the region. Nevertheless, not only was one blade completely lost, but the tip of another was knocked off.

We did not reach the anchorage abreast of the village in the north arm of Magdalena Bay until 11 a. m. but work was begun immediately thereafter. Captain Nelson proceeded to "swing ship" and check up on his compasses. Mr. Mason collected about 45 species of plants in bloom and Mr. Keifer took many fine insects. Mr. Jordan collected fossils in the bed just north of the village which I had investigated in 1922 and his careful search was rewarded by the finding of several species I had not taken. Mr. Slevin captured a snake which was not previously known from the vicinity. Mr. Duhem and I suffered the greatest disappointment of all. We rowed into the eel-grass of the lagoons in the north arm of the bay in order to search for live sea horses to take back to the Aquarium. Up to this time as well as later on the trip we devoted much time to this search, but except for the one specimen taken by the submarine light at Maria Madre Island, we were unsuccessful. The species is probably common enough in certain favorable localities wherever we went, but we were not able to find these places.

In the evening we were visited by Captain Bryde in charge of the floating whaling station. He belonged to a Norwegian company which had extensive plants in the antarctic region. His was the second vessel from the company to have come to Magdalena Bay and he said that since December, 1923, they

March 30, 1926

had taken 750 whales. Of these he said they were divided about as follows:

California Gray	130
Humpback	310
Blue (<i>Ballena sieboldi</i>)	310

This classification seemed so unusual to me that I raised the question of accuracy of identification, but he assured me that it was correct. We had come to the conclusion from other data that the California Gray whale was almost extinct, but if Captain Bryde's figures are correct, there are some still left. I was also inclined to doubt the accuracy of the identification of the blue whale, but he stated it was a species with which he had become very well acquainted in the antarctic and he knew its characters well. Nevertheless, I was not convinced, but repeat the records here for what they may be worth.

Captain Bryde told us he had recently paid Socorro Island one visit with his harpoon steamers and had killed three whales there but they had so decomposed on the long tow to Magdalena Bay that they could not be used in the factory. I cite the incident merely to show what little regard some commercial interests have for the utilization or actual continuation of that life from which they derive their revenue.

The region about the Revillagigedo Islands has long been known as the "cow pasture" in whaling parlance because so many whales go there to rear their young. Professor Contreras stated that the same was true of the Gulf of California above Carmen Island. It is hoped that, in view of these circumstances, these localities may be made into a reserve where the young whales may live for a little while without molestation.

May 30—Messrs. Slevin, Mason, Jordan, Wright, Duhem, Musser and I went south of the village about four miles in the motorboat in the early morning and walked back along the beach, making many valuable collections. Fortunately, there had been rain at a recent date and most of the desert plants were in bloom. This of course made Mr. Mason very happy because it has been said that several years have passed at a

stretch at this locality without a measurable quantity of rainfall. Many of the elephant trees were gorgeous masses of pink blooms and some had leaves.

Mr. Jordan and I succeeded in collecting some species of Pleistocene fossils which were not found in the deposit north of the village, and also, during the low tide some very desirable living species were found. A species of land shell, a *Bulimulus*, was found under the rocks on the hillside; this is apparently the same one which is found on Margarita Island to the southward and marks the extreme northward extension of the remarkable "Cape Region" land shell fauna in Lower California.

The village of Magdalena Bay is located near the north end of a series of hills which form a ridge separating the bay from the ocean and in position being comparable to Marin County, California. It was in and along these hills that we collected today. At the point four miles south of the village where we began operations, the rocks are old schists dipping to the west-south-west at an angle of about 60° . The beds are crossed in every conceivable direction by dykes and stringers of quartz, some being two feet thick in places. Some of the quartz veins have copper stains, and to the northward, back of the village where they are eight feet thick or more, they have evidently been prospected sporadically; we saw several shallow pits which had been dug along contacts but with what success we were unable to learn. There have apparently been some intrusions of granite and diorite and the locality would seem to warrant the attention of an expert mineralogist.

Along the beach south of the village there are late Pleistocene deposits, composed chiefly of coarse detrital matter, firmly cemented. Many fossils were found therein, the dominant forms being such as would live among coarse gravel, and large rocks as *Chama*, *Spondylus*, and large clams. North of the village the sediment was finer, Mollusca were more abundant and no cement has been formed. Thus it is one of the finest fossil collecting localities in western North America. We have taken almost 400 species from the deposit.

The captain of the whaling establishment paid us another visit in hopes of being able to borrow \$4,000. It appeared

that his concession was to expire on May 31, and he needed that amount to meet his taxes to avoid forfeiture of bond. We were not in a position to offer any aid to such an enterprise and, since we left Magdalena Bay that night, we did not hear how he fared later.

May 31—The day was spent at sea cruising northward toward San Bartolome Bay at slow speed owing to our injured propeller.

June 1—At 9:30 a. m. we had anchored in San Bartolome Bay and went ashore in the south arm known as Turtle Bay. It is well named, too, because we saw there on the beach the remains of a great many turtles which had been killed in the past and about a dozen live ones were on hand awaiting slaughter or transportation to some other fishing camp. We had succeeded in getting one turtle alive in Magdalena Bay and here added another to take back to the Aquarium. In transporting them it is customary to turn them on their backs and we tried this but after witnessing the obvious distress in which they constantly appeared to be, the officers constructed a deck tank of timbers and sail cloth; in this the animals appeared to be very happy during the remainder of the voyage.

A Japanese, Mr. Condu, has a concession for drying abalones at Turtle Bay and he had many racks filled with the meats. The process is essentially the same as that followed on Cedros and the San Benito islands described in the report of the Guadalupe Island Expedition.¹² Mr. Condu also has the concession for lobster fishing on this part of the coast, the work being carried on during the winter months.

Most of the collectors had a very disappointing day due to the excessive aridity which has prevailed for a long time. Five small sparrows, a thrasher and a few ravens were all of the land birds seen by the party. Pelicans, gulls and cormorants were common on the bay. Mr. Mason took only 15 species of plants, contrasting with 45 taken in one day at Magdalena Bay.

¹² See Hanna, Proc. Calif. Acad. Sci., Vol. 14, No. 12, Sept. 5, 1924, pp. 248-249-272.

Mr. Jordan and I were more successful. We went east about three miles into the hills and collected a large number of fine Pliocene fossils. Below the obviously Pliocene beds there was a thick deposit of light, gray-colored shale and at the base of this a sandy layer in which we found numerous shark teeth, some sea lion teeth and pectens. It was believed that this layer could be correlated with the famous deposit of shark teeth in Kern County, California, usually referred to the Upper part of the Miocene. Below this fossiliferous layer, heavily bedded conglomerate, probably Cretaceous in age, extended downward an unknown distance.

June 2—All of the party except Messrs. Gallegos and Solis went ashore in the north arm of San Bartolome Bay and the day of collecting was marked with only fair success. The ornithologists took about a dozen birds but none appeared to be of special importance. Mr. Slevin got several lizards and a rattlesnake; the latter was killed by Messrs. Mason and Keifer. Mr. Keifer found some very desirable insects and Mr. Mason took four or five species of plants he did not get the day before. Elephant trees thrive and grow to almost as large size as on Cedros Island. Two specimens of giant cactus were found, both in flower. The country, in the main, is excessively barren. An old lobster fisherman, living alone in a tent on the beach, stated that during the previous winter there had been only two slight sprinkles of rain. Nevertheless, coyotes, woodrats, kangaroo rats, pocket mice and two species of rabbits do well. The old fisherman catches lobsters in the winter time and exists alone in his tent the remainder of the year. Most of the freshwater used in the vicinity is shipped in from San Diego; a small quantity comes from Cedros Island.

June 3—We left Turtle Bay at 4 a. m. and arrived at Bernstein Bros. abalone plant on Cedros Island at 9 a. m. All of the party went ashore and had a very successful day, collecting.

Mr. Slevin, in addition to other things, took one of the rare alligator lizards, one of which was caught in 1922 in a mouse trap. A rattlesnake and a gophersnake were taken by other members. Messrs. Mason and Solis filled their presses with

desirable plants, having collected up the cañon back of the camp, but they did not reach the spring. Messrs. Tose and Keifer went to the spring in the late evening prepared to camp overnight.

Messrs. Jordan, Duhem and I collected fossils in the Pliocene beds south of the camp and got a great many very desirable things. These strata dip in part toward the island mass, 20° west; again they dip 15° east; then they lie flat, all within a half mile on the strike. This great discordance shows that there has been much faulting and thrusting. Fossils, especially pectens, are excessively abundant and, in the main, well preserved. The beds are white or buff sands and conglomerates, the light colors being due to coralline algæ.

In the afternoon I visited some shale hills up the main cañon back of the plant. These were composed of muddy shales with occasional layers of thin, hard sandstone. They dip to the westward at an angle of about 30° . I had looked these over for fossils in 1922 and failed to find any, but this time I was more fortunate. I found one layer which contained Foraminifera, Inoceramus and Ammonites. The formation was thus proved to be of Cretaceous age and since it resembles some rocks found about Turtle Bay and Abreojos Point so closely, I have no hesitation in classing them as the same.

June 4—Collections were again made from Bernstein's camp as a base and numerous desirable things were found. Members of the party collected five rattlesnakes and Mr. Mason and I took another specimen of the alligator lizard.

Messrs. Tose and Keifer took nothing of importance at the spring during the night. Mr. Mason and I went up today and Mr. Keifer went back with us. Many desirable specimens were taken which are found only at that place. I carried the camera and took some excellent photographs of this little oasis and the plants thereabout. The agaves were beautiful objects to behold, the long stems being crowned by brilliant golden-waxy clusters of blooms. Each blossom was filled with a sweetish liquid, slightly fermented for the purpose of attracting insects, apparently. We visited the giant cactus plant Mr. Slevin and I found in 1922 and Mr. Mason pronounced it the

same species as that found at Turtle Bay. Two other cacti were found, making a total of six species from the south end of the island.

Some of the beauty of the oasis about the spring had been marred by fire since 1922, but it still stands as a gem in this barren and parched desert. A very large volume of water comes out of the supposedly Jurassic schist, 2500 feet above sea level and two or three acres are covered with a dense growth of grasses. Many flowers were in full bloom. The juniper trees were laden with dark colored fruit and the *Rhus lentii* trees were covered with masses of pink fruit. Little green tree frogs hopped from leaf to leaf as we passed through the dense vegetation and an occasional katydid gave us a feeble song.

In 1924 some date palms were planted about the spring and along the creek leading from it. They were found to be about a foot high and seemingly doing well.

Messrs. Jordan and Wright went south into the Pliocene country again and came back with another excellent collection. They found 500 feet of Miocene rocks dipping northwest beneath the Pliocene. In the lower beds were found shark teeth, whale bones and other fossils which appeared to identify the deposit with that previously found at Turtle Bay.

June 5—During our stay at Cedros Island, Captain Nelson continued the checking of his compasses, the water off the east coast being comparatively calm. Before proceeding with that today he took us to the Grand Cañon near the center of the east side of the island.

Messrs. Mason, Keifer and Tose went to the pine forest on the north rim of the cañon. Several plants were found which had not previously been taken, the most conspicuous, aside from the pines being the California Christmas berry, an oak-like shrub. Mr. Tose saw a flock of goldfinches and took one; no other birds were seen.

Messrs. Slevin, Solis, Contreras, Wright and Duhem worked up the main cañon as far as the old stone house used by the mining company's prospectors years ago.

Messrs. Jordan and I gave the day to the study of the rather complicated geology in the vicinity. It was found that a fault line crosses the island following approximately the course of the cañon. To the south only, Jurassic cherts, supposedly Franciscan in age, were found. To the north there is a block of Cretaceous shales, 2000 or more feet thick, with a general westerly dip of about 30° . On the east coast this extends northward about three miles where it is again abruptly cut off by a cross fault, the rocks to the north being apparently Jurassic, but they were not closely examined.

On the eastern shore about two miles north of the Grand Cañon, there is a small block, 100 feet thick, of Miocene cherty shale, and this in turn is overlain by Pliocene sands and conglomerates, very fossiliferous. All dip to the eastward or northeastward at angles up to 20° and are overthrust by the Cretaceous block, the line of contact dipping westerly at an angle of about 30° . Many fine fossils were collected from the Pliocene, among them being *Pecten cerrosensis* and *Pecten veatchii*, two long-lost but remarkably fine species not found since they were originally collected on Cedros Island by Dr. Veatch about 1860.

Our studies convinced us that Cedros Island is in a zone of intense block faulting and disturbance. At the present time, except for a comparatively recent post-Pleistocene uplift of little significance, the island is in a period of depression. In other words, at no very distant period geologically, the island was a part of a very much higher land mass. This probably accounts for the presence of so many freshwater springs in so arid a region.

June 6—We left our anchorage at Cedros Island at 1 a. m. A gale had been blowing from the northwest all of the previous day, so when we got out of the protection of the east side of the island, a terrific sea was running, causing the ship to roll and toss considerably. It gave the party an excellent opportunity to discover all the loose ends not properly secured for sea,—and there were many. Fortunately no specimens or equipment were injured.

Captain Nelson desired to proceed to a point westward from Cedros and about two miles west of the San Benito Islands to sound out a shoal supposed to be there. He also wished to investigate a patch of breakers north of those islands. The position and size of the first and the existence of the last are marked as doubtful on the sailing charts. The departure from Cedros was timed so that we would be near the supposed positions at dawn, but when daylight came, it was quite obvious that survey work in that tempestuous sea was impossible. The course was changed toward San Quintin Point and this headed the ship directly into the wind and sea; owing to the injured propeller, slow progress was made. A little over five miles per hour was the best that could be made. It was too rough to accomplish any useful work on board so a holiday of rest was enjoyed by all.

June 7—Anchor was dropped back of San Quintin Point at 3 a.m. and at six Messrs. Gallegos, Jordan, Mason, Keifer, Duhem, Wright and I left the ship in the motorboat, bound for the village of San Quintin, 12 miles inland. I had been through the tortuous lagoon channels twice in 1922 and remembered enough of their course so that we managed to get through safely. The chief danger with small boats lies in crossing the lines of breakers at the outer bar. It is necessary to keep well over toward the shore on the left side going in to avoid them. Some black lava rocks outcrop on the beach where it is necessary to go closest. Once inside the bay, or lagoon as it is called on the charts, it was glassy smooth and a fairly deep channel meanders down the center line with broad mud flats on either side. Part of the channel is marked with piling but the outer portion must be navigated with considerable care to keep from grounding.

The chief object of our trip to San Quintin village was to give me an opportunity of making a geological investigation of a large tract of land on the "Plains of San Quintin." An automobile was obtained at the village and Sr. Gallegos and I, accompanied by two local residents, Messrs. Cannon and Green, spent the day travelling. We went as far as "Red Rock



Ranch" owned by Miss Hamilton and there we found Mr. Laurence M. Huey, of the San Diego Society of Natural History. Mr. Huey was busily engaged in making a collection of birds and mammals of the region. The ranch is irrigated with water from the Santo Domingo River which at that point flows out of the high mountain to the eastward upon the plain. Above the ranch a few miles is the old settlement of Santo Domingo with the ruins of the mission built by the padres.

The Plain of San Quintin is about four miles wide and 20 to 30 miles long. It is gently rolling throughout and the topography is not due to erosion but to uneven sea bottom or to folding such as has exposed the Pleistocene sediments at the village about 12 feet above sea level. Far out in the center of the plain marine fossils of Pleistocene age were found on or near the surface.

East of the Plain there is a long straight escarpment or terrace 50 to 75 feet high, the top being a mesa from one to four miles broad. This is deeply eroded with stream channels and is unquestionably older than the Plain. There is no appreciable development of alluvial fans on the Plain in front of the streams which is practically certain indication that the Plain was under the sea when the channels were being cut. The escarpment, therefore, is an ancient shore line. I was unable to find any fossils in the sediments exposed in the escarpment where we crossed it, but it could hardly be expected to be older than Pliocene.

There is a possibility that the escarpment might be a fault line, antedating the deposition of the Pleistocene of the Plain. This, however, does not seem to be a plausible explanation of the observed features.

Back of the mesa there is a range of rugged hills cut with deep cañons. The exposed rocks noted were all metamorphic, schists and slates predominating. These have a steep dip toward the Plain near the mouth of Santo Domingo River and if this generally prevails along the western side, it should certainly increase the possibilities of getting artesian water on the Plain. In view of the large area of excellent farming land

which could be brought into cultivation if artesian water exists within reasonable depths, this development would seem to be worthy of serious attempt.

In this connection it is worth recording that the deepest well of which I learned was put down to 68 feet on the Rancho Escoras on the Plain. Excellent water was obtained in sufficient quantity to supply domestic needs and irrigate the ranch garden.

At Red Rock Ranch I saw two beautiful specimens of Cretaceous ammonites with most of the pearly shell preserved. They were reported to have been collected at Ekatarina Landing in the vicinity of Rosario Bay by a Mr. Moody, petroleum geologist who located a well which was being drilled. No details of the well or the fossil occurrence were available, but it was stated by Miss Hamilton that some of the ammonites there were nearly three feet across.¹³

We returned to the village of San Quintin at 4:30 p. m., where the other members of the party ashore had made some important collections. The ship was reached at 6:30 p. m.

June 8—We left the San Quintin Point anchorage at 5 a. m. and reached San Martin Island at 7 a. m. We desired to make as complete collections as possible from this remarkable volcanic islet in the time available because of the number of species found there and no place else.

The island is almost circular, one mile in diameter and with a boulder spit on the southeast side. The western part is 400 feet high and composed of scoria and other volcanic ejectamenta. This makes a cone with a beautiful and perfect crater in the top. Lava flows form the remainder of the island (except the spit) and make the surface excessively rough and difficult to travel over.

Four or five species of land shells were found among the blocks of lava and numerous insects and spiders were taken by Mr. Keifer, assisted by Mr. Wright and me.

¹³ One magnificent specimen brought back by Mr. Moody came into the possession of Mr. Charles H. Sternberg, the veteran collector, and has been acquired by the San Diego Society of Natural History; it is fully 18 inches across. Another is in the possession of Mr. David Goldbaum of Ensenada, Lower California.

The land birds consist of a sparrow and a wren, neither one abundant. Pelicans, western gulls and cormorants nest in very large numbers.

Mr. Wright and I went back 100 yards into a lava cave and found a pile of at least five bushels of bones of small mammals. A few barn owl features gave a clue to the cause of the accumulation.

California sea lions occupy the beaches of the west side.

No recent rain had fallen and as a consequence annual plants were not available, but Messrs. Mason and Solis succeeded in getting about 25 species of perennials. Among these were the beautiful endemic *Dudleya* and four or five species of cactus. One of the latter forms a carpet over some large areas and is very difficult to walk over.

Mr. Duhem captured one of the snakes belonging presumably to the species we had seen on San Martin in 1922 but failed to get. According to Mr. Slevin, this was a very desirable addition to our collection.

The little harbor (Hassler Cove) formed by the boulder spit is a haven for small motor-driven fishing craft. Some Japanese had a camp on shore where they were drying and baling seaweed to be shipped to San Diego, presumably for the manufacture of agar-agar.

Piled high on the beach was a portion of a wreck of a motor-boat which had burned to waterline at no very distant date.

June 9—The work at San Martin Island completed the modified program we had outlined after the accident to the *Ortolan* and San Diego was reached at 8:45 a. m. Our reduced speed and increased fuel consumption had left us only about one day's steaming supply when we went to the oil dock at La Playa.

I proceeded to San Francisco by rail from San Diego.

June 10-12—The *Ortolan* left San Diego at 7 a. m. June 10 and the last lap of the journey was completed at 6:30 p. m. June 12 when the ship tied up at the pier in San Francisco and the party disbanded. Much to the pleasure of all of us, Messrs.

Contreras, Gallegos and Solis came on to San Francisco with the ship and spent several days visiting points of interest thereabout.

Little did we think that when we said goodbye upon their departure it would be our last opportunity to see our most congenial companion of two expeditions, Professor José M. Gallegos. He returned to San Diego for a brief period, then went to Mexico City to prepare for aiding in the eradication of the grasshopper plague of certain sections of his country. Investigations were necessary in Guatemala and while on his way there he was stricken with fever in Beliz, British Honduras, where he died on September 24, 1925. Words cannot express the sorrow felt by all of his Academy friends upon the receipt of this sad news.*

* On March 10, 1926, after the foregoing pages were in final proof, another member of the expedition was taken from us. In an automobile accident near Gilroy, California, Mr. Eric Knight Jordan received injuries which resulted fatally a few hours later. Mr. Jordan and an assistant, Mr. Leo G. Hertlein, had just started upon a field trip for paleontological work in southern California, when the accident occurred.

On October 1, 1924, Mr. Jordan, at the age of 20, became connected with the California Academy of Sciences as a scientific assistant in the Department of Paleontology, and on April 1, 1925, he was appointed Assistant Curator of that department, which position he held at the time of his death.

Eric Jordan was a young man of unusual promise and, had he lived, would undoubtedly have attained eminence in paleontological science. In his death science and the California Academy of Sciences have suffered irreparable loss.

PLATE I

Fig. 1. The members of the expedition at the oil dock in San Diego before departing. Reading from left to right they are:

Prof. Francisco Contreras	Mr. Eric Knight Jordan
Mr. Frank Tose	Captain M. M. Nelson
Dr. G. Dallas Hanna	Mr. Hartford H. Keifer
Mr. Raymond Duhem	Mr. H. L. Mason
Prof. José M. Gallegos	Sr. Ing. Octavio Solis
Mr. Joseph R. Slevin	Mr. John L. Wright

Photograph by Laurence M. Huey.

Fig. 2. U. S. Navy Mine-sweeper No. 45, the *Ortolan*, anchored at Sulphur Bay, Clarion Island.

Fig. 3. A Clarion Island dove resting on a mass of vines; these birds were very tame.



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PLATE II

- Fig. 1. Outer Island at the south end of Guadalupe Island. This mass of lava has a crater in which there is water but whether this is fresh or salt has not been ascertained.
- Fig. 2. Two of the ground owls of Clarion Island at the entrance to their burrow beneath the dense vegetation.
- Fig. 3. A beautiful blue morning glory was in full bloom on Clarion Island at the time of our visit.
- Fig. 4. Starving young man-o-war birds, the brood of 1924, on the high grass-covered plateau of San Benedicto Island. Photograph by Neil B. Musser.
- Fig. 5. Method of landing on a lava shelf in a small bight just west of Sulphur Bay, Clarion Island. Photograph by Neil B. Musser.



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PLATE III

- Fig. 1. Pink fruit of *Rhus lentii* on Cedros Island: this fruit was very sour, and in the thick gummy substance on the surface there were many insects apparently belonging to the family Aphidæ.
- Fig. 2. Mr. Duhem photographing a turtle at low tide on the coral reef of Sulphur Bay, Clarion Island.
- Fig. 3. Prof. Gallegos with a fine specimen of the yellow-headed, Tres Marias parrot.
- Fig. 4. Monument Rock at the west end of Clarion Island.



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PLATE IV

Fig. 1. The beautiful blooms of a species of cactus found growing on San Martin Island.

Fig. 2. A view of the excessively barren landscape at San Bartolome Bay, Lower California.



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PLATE V

Fig. 1. A forest scene on Maria Madre Island.

Fig. 2. A huge nest of termites on Maria Madre Island.



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PLATE VI

Fig. 1. The Ash Heap, a deeply scored mass of volcanic debris at the south end of San Benedicto Island.

Fig. 2. One of the outlying bird-covered rocks at Isabel Island.



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PLATE VII

- Fig. 1. Young sooty terns on Isabel Island.
- Fig. 2. Adult sooty terns on Isabel Island.
- Fig. 3. The red-billed tropic birds were more numerous on Isabel Island than elsewhere and we found them nesting in deep caves on the cliffs.



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PLATE VIII

- Fig. 1. Noddy tern and egg on Isabel Island.
- Fig. 2. One of the few individuals of giant cactus found growing in the excessively arid region about San Bartolome Bay.
- Fig. 3. Male man-o-war bird on nest made of Euphorbia sticks, San Benedicto Island.



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PLATE IX

- Fig. 1. Roca Partida; this appeared to be a granitic pinnacle projecting upward from very deep water.
- Fig. 2. Alijos Rocks; the one on the right is North Rock, the center one is East Rock and the one on the left is South Rock; the latter two are adjacent in the picture but the three form an almost equilateral triangle.
- Fig. 3. Webster's booby on nest at Clarion Island.



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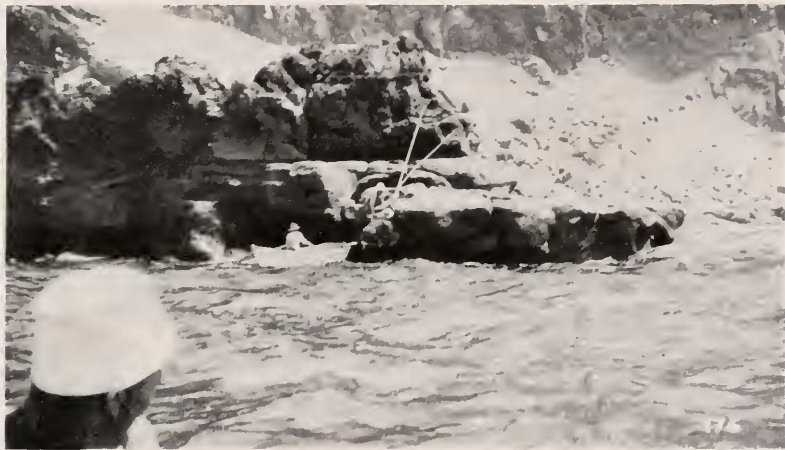
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PLATE X

- Fig. 1. Curiously sculptured rocks on the west side of San Benedicto Island.
Photograph by Neil B. Musser.
- Fig. 2. A landing on San Benedicto Island was made under considerable
difficulty. Photograph by Neil B. Musser.
- Fig. 3. One of the steam vents near the top of Mt. Evermann on Socorro
Island.



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